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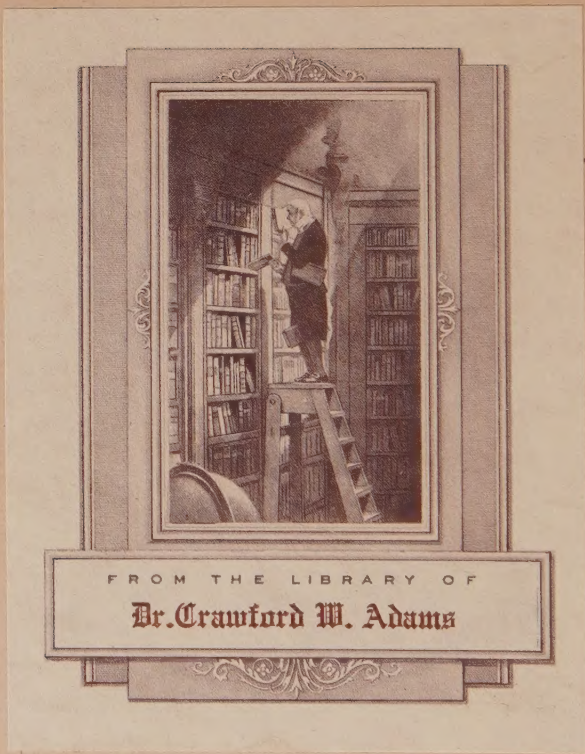

# DISEASES

OF THE

# NOSE, PHARYNX,

AND

# EAR

BY

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# PREFACE.

THIS volume is intended to present disease as the author has seen it during an experience of nearly twenty-five years, while in touch with the work of others. It has been the author's aim to answer in detail those questions regarding the course and outcome of diseases which cause the less experienced observer the most anxiety in an individual case—questions to which an answer is not easily obtained from text-books. In order to carry out this plan, the book could not be written with the brevity and sharp subdivision of topics which have made some of the smaller works popular with students. A text-book should present to the student all the facts bearing on the subject, and present them in their logical development. But, on the other hand, the work is not intended as an encyclopedic treatise, and hence lacks the literary and historical completeness proper to the latter. In the therapeutic part the author has aimed to detail only those procedures which have stood the test of critical experience, and to omit those that have failed under this test, even though sanctioned by the tradition of text-books.

As a requisite for all surgical work, topographic anatomy has been given a liberal space. Since anatomic statements are necessarily based upon the labor of professional anatomists, it has seemed proper to the author to draw, as well, upon the superior illustrations in some of the anatomic works less accessible to the English student. It is especially to the works of Zuckerkandl and of Politzer to which he is indebted for anatomic illustrations.

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# *BOOK I.*

# DISEASES

OF THE

# NASAL PASSAGES AND PHARYNX.

## CHAPTER I.

### DEVELOPMENT, GENERAL DESCRIPTIVE ANATOMY, AND PHYSIOLOGY OF THE UPPER AIR-PASSAGES.

**1. Development of the Upper Air-passages.**—The upper air-passages from nostril to larynx are developed from three different starting-points during embryonic formation. The **nasal** or **olfactory fossæ** begin in the form of two pits between and at the level of the embryonic eyes. They are separated from each other by the relatively very thick median frontal process, the lower curved end of which becomes transformed into the upper lip. Underneath this area the broad fissure constituting the primitive **mouth** reaches at first inward only as far as the closed anterior or ventral wall of the **esophageal end** of the **intestinal tract.** The intestinal tube itself extends in the form of a blind pouch up to the rear end of the base of the skull. The subsequent coalescence of mouth and esophageal pouch forms the pharynx. Meanwhile the nasal fossæ continue to grow inward and to elongate downward. At this period they are but shallow longitudinal fissures, opening merely in front. The **external nose** covering the facial end of the nasal passages is a product of a much later stage of fetal development. The floor that separates the nasal fossæ from the mouth —the **primeval palate**—is the matrix of the intermaxillary

bone, and has nothing to do with the subsequent true palate.

In the next place the nasal pits perforate into the mouth. For a time the nasal passages, separated from each other by the thick septum, form one continuous space with mouth and pharynx. A relatively rapid growth of the nasal fissures takes place in the direction from the facial orifice to the pharynx, while the median wall between the nasal fissures is being prolonged by a downward growth of a partition from the base of the skull as well as by the elongation of the primitive septum. The final nasal septum is thus formed from an anterior, as well as from an upper rear starting-point. This double development is indicated during subsequent life by separate arterial and nervous supply of the front and posterior areas of the median nasal wall.

From the matrix of the superior maxillary and palatal bones transverse plates begin to grow, which, by joining finally in the median line, form the palate and thus separate the nasal passages from the mouth. An arrest of development of these plates constitutes the deformity known as cleft palate. The orifices which remain at the rear end of the nasal fissures after the completion of the palate form the posterior choanæ.

**2.** By the time the palatal plates have united with each other and with the buccal edge of the nasal septum each nasal passage has become surrounded with a cartilaginous capsule, of which the portion common to both sides is formed by the cartilaginous plate in the septum. On the external wall of each nasal passage a series of ridges, usually six in number, but with accessory extensions, now develop in the lining, which is transformed gradually into mucous membrane. The ridges, curved with the convexity downward, converge from the front and the roof of the nose toward the posterior choanæ. As these ridges change into projecting crests, cartilaginous lamellæ, more or less curved, develop in them and form the turbinal processes, or conchæ. In man but two of

these projecting lamellæ retain a pronounced prominence —the inferior and the middle turbinal. The others—viz., the two below the middle turbinal (the ethmoid bulla and the uncinate process), as well as all above the middle turbinal (the ethmoturbinals)—recede relatively in development, become more or less curved upon themselves, and coalesce to some extent. The space between the septum and the turbinal processes represents, finally, the olfactory fissure and the nasal passage proper, whereas the spaces included between the coalesced turbinal processes develop into the accessory cavities or nasal sinuses. The formation of the ethmoid cells is thus a relatively simple inclusion, while the frontal and maxillary sinuses grow by further extension into the corresponding bones. The sphenoid sinus, however, represents really the posterior (upper) portion of the nasal passage itself, shut off by accessory turbinal partitions. It is only after birth that these temporary walls around the sphenoid sinus atrophy and leave the cavity surrounded by its permanent bony capsule, formed by the body of the sphenoid bone.

**3.** The infantile nasal passage differs from the fully developed cavity not alone in its absolute, but also in its relative, dimensions. The olfactory area, or, more properly defined, the region bounded by the ethmoid bone, is developed during fetal life more fully than the lower or respiratory channel outlined by the maxillary and palatal bones. The subsequent growth in the vertical height of the nose hence depends mostly on the postnatal elongation of the superior maxilla. The nasal passage of the infant is relatively very narrow, although the extreme width of the fetal septum has become reduced at birth to the proportion maintained during adult life. The inferior turbinal is, however, so close to the floor and relatively so broad that the inferior nasal meatus is scarcely apparent until about the third year; hence inflammatory swelling during acute coryza is more serious in babes than in later life.

Growth also occurs in the sagittal direction. Until the sixth year the transverse plane of the posterior choanæ corresponds to the level of the infantile molar tooth (second bicuspid of the adult). In the course of the second dentition the palate, and with it the nasal walls, elongate so that finally the choanæ lie in a plane with the third molar teeth. The accessory sinuses are all relatively very small and imperfectly developed at birth. Their growth is slow until after the second dentition.

The **pharynx** at birth is about one-half the size of the adult cavity, except in its width, it being rather more than one-half as wide. The growth of the maxilla and the vertical plate of the palatal bones causes a gradual displacement of the pharyngeal orifices of the Eustachian tubes relative to the floor of the nose. These orifices, situated below the palate in the fetus, reach the level of the palate at birth and ascend, until the eighth year, to the height of the rear end of the inferior turbinal.

**4. General Descriptive Anatomy.—The Nasal Cavity.**—The gateway to the nasal cavity is the pyriform aperture, bounded above by the nasal bones, on the sides and below by the edge of the superior maxillary bones. The intermaxillary portion of the latter forms a sharp-pointed median crest—the anterior nasal spine. The **bridge of the nose** is built up by the nasal process of the frontal bone, the frontal process of the superior maxilla, and the two nasal bones joined in the median line, while on the internal side of this junction the nasal septum is inserted. The relative extent of cartilaginous portion of the septum and bony portion (perpendicular plate of the ethmoid) participating in this articulation varies considerably in different subjects. The shape and strength of the bridge of the nose protect the septum against traumatic fracture from a blow unless this be sufficiently intense to fracture the bridge itself. The shape and prominence of the nasal bones are pronounced racial characteristics. By its protruding nasal bridge the Caucasian skull can be distinguished from that of other races.

Below the nasal bones the **external nose** has a cartilaginous framework (Fig. 1). The septal or quadrangular cartilage gives off two approximately triangular wings, the triangular cartilages, which, forming the middle part of the side of the nose, adjoin the lower edge of the nasal bones, but overlap them on their internal side. Below this level the cartilaginous septum does not reach to the tip of the nose, the gap in the partition wall being completed by the movable membranous septum. The lower part of the nasal side contains the two cartilages of the nasal wing, each a thin plate reaching from the triangular cartilage to the tip and curved anteriorly so as to insert its "doubled" median border into the membranous septum. In the nasal wing this cartilage is fragmented vertically, thereby

FIG. 1.—Front view of the external nose after removing the skin, showing the nasal bones, quadrangular and triangular cartilages (Zuckerkandl).

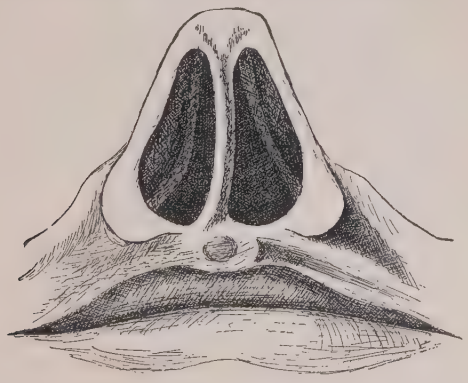


FIG. 2.—View of the nasal vestibule from below, showing the prominence of the fold (Zuckerkandl).

giving the nose flexibility. The triangular cartilage overlaps the lower cartilage likewise on the internal side,

and its prominent border appears as a projecting, horizontal fold, the plica vestibuli, which may be considered as the threshold of the nasal cavity, the space outside being the vestibule (Fig. 2).

The external skin lines the vestibule and changes gradually into mucous membrane at about the level of the protruding fold. As far as there is true skin the vestibule is protected against insects by coarse hairs—the vibrissæ. The external muscles surrounding the sides of the nose dilate the nostrils, while their relaxation results in collapse of the sides of the nose, variable with its degree of flexibility. The muscles are innervated by the facial nerve.

**5.** The **nasal cavities** are surrounded entirely by bony walls, but are separated from each other by the septum, which in its front portion remains cartilaginous. The floor of the nose is made up of the palatal process of the superior maxillary and the horizontal plates of the palate bones. It is a level, shallow gutter. The floor is the shortest of all the nasal walls, as the rear edge of the middle wall slopes backward and upward, besides being slightly concave toward the rear. As the free border of the septum determines the plane of the nasal opening into the pharynx, all nasal walls exceed the floor in length.

The middle wall or septum presents normally a nearly plane surface. The anatomic peculiarities of this wall will be considered in Chapter XVI.

The **roof,** completed in front by the awning of the nasal bones, consists of the cribriform plate of the ethmoid bone anteriorly, and of the body of the sphenoid bone in its posterior half. The ethmoid plate is the weakest part. The anterior surface of the sphenoid body slopes down and backward, while the inferior surface of this bone has, likewise, a slight slant toward the rear and down. The nasal space is hence considerably lower in the rear than in front (Fig. 3).

The **external wall**, the most complicated of all, is formed by three bones. The greater area below the floor of the orbit consists of the nasal surface of the superior maxilla, separating the nasal cavity from the maxillary sinus. From this there extends upward the narrow frontal process of the maxillary bone, which articulates posteriorly with the lamina papyracea of the

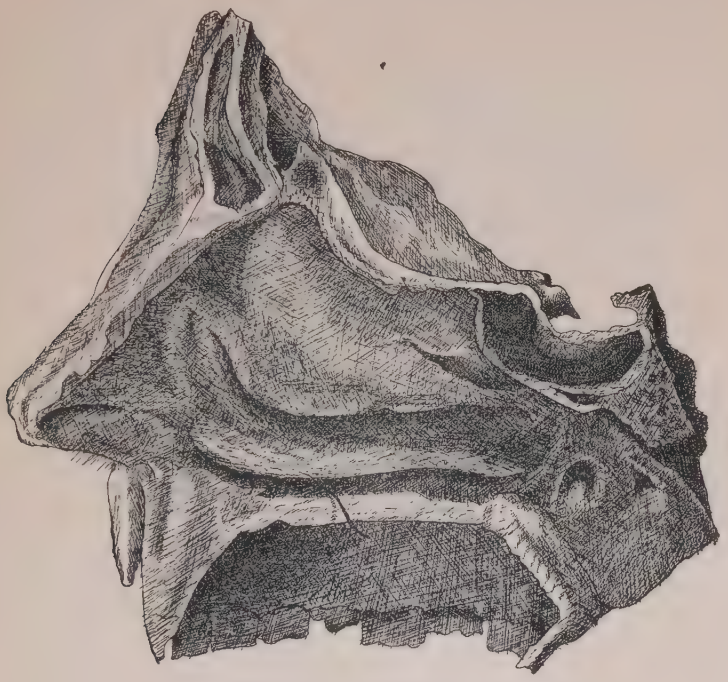


FIG. 3.—View of the external wall of the right nasal passage, with probes in the sphenoid sinus and in the nasal duct (Mihalkovics).

ethmoid bone, forming the partition wall between the orbit and the upper part of nose. At its rear edge the lamina papyracea joins the anterior surface of the sphenoid body, which, by its presence, reduces the height of the nasal passage. Below the sphenoid bone and posterior to the superior maxilla the external wall consists of the vertical plate of the palate bone.

The space inclosed by the nasal walls is approximately rectangular, but is encroached upon in such a manner by accessory bony structures, arising from the external wall, that each nasal cavity proper is reduced to a nearly triangular cross-section with a roof only 2 or 3 mm. wide, while near the floor each side is from 12 to 18 mm. wide.

The bony ledges, which thus reduce the width of the

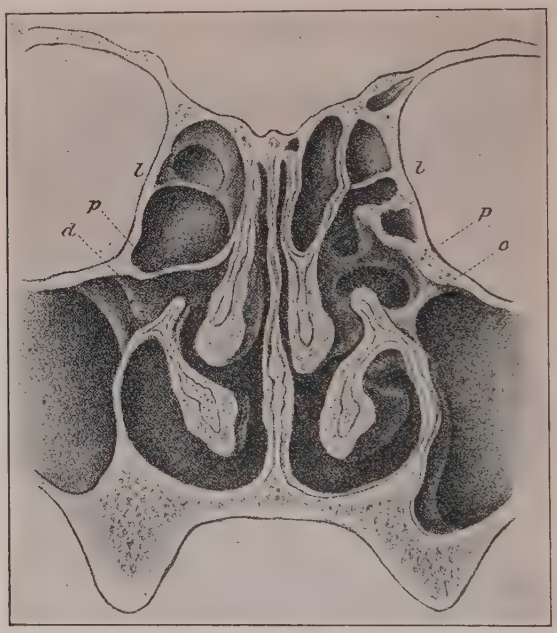



FIG. 4.—Frontal section through the nasal passages at the level of the orifice of the maxillary sinus. Anterior half seen from the rear: $p$, $p$, Uncinate process and, external to it, the hiatus semilunaris; $c$, anterior half of maxillary orifice; $d$, infundibulum; $l$, $l$, lamina papyracea (Zuckerkandl).

nasal passage, are the turbinate processes or turbinals (or conchæ). During embryonic formation there are six main turbinal ledges or projecting lamellæ, with a variable number of minor shelves between them. They follow a curve with its convexity downward and forward, and converge toward the posterior choanæ. By coalescence and partial arrest of development the number of turbinal ledges becomes reduced, so that at birth there

are but four or five. The inferior turbinal is a separate bone—a thin lamina in the form of a curved, overhanging ledge, a short distance above the floor, which begins within 1 cm. behind the pyriform aperture and ends in the plane of the posterior choanæ, where its end is slightly rolled upon itself. It articulates with superior maxilla, palate bone, and lamina papyracea of the eth-

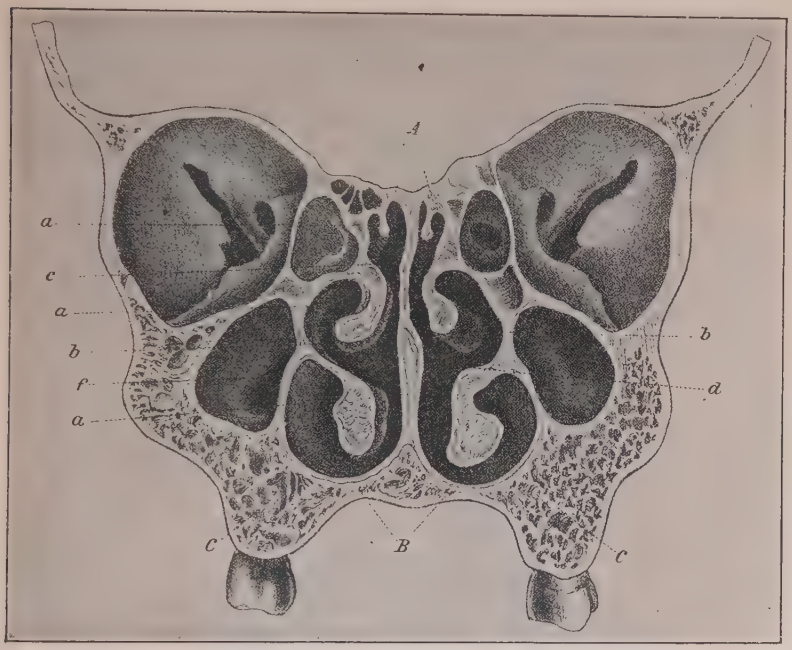



FIG. 5.—Frontal section through the rear part of the nasal passages: *A*, Roof; *B*, floor; *f*, external wall of nasal passages; *C*, *C*, alveolar process, high and spongy; *a*, *a*, *a*, the three nasal meati; *b*, *b*, middle turbinal; *c*, olfactory fissure; *d*, respiratory fissure (Zuckerkandl).

moid. The space underneath it is the lower meatus; the channel above it, the middle nasal meatus. The other turbinal processes are part of the ethmoid papyraceous plate. Of these, the middle turbinal is the most independent. It conforms, on the whole, with the shape and inclination of the inferior concha, begins about 1 cm. posterior to the front end of the latter, ending like the

latter in the plane of the posterior choanæ with a similar rolled end. In the living, no structure above the middle turbinal can be recognized. Dissection, however, shows one well-defined, though smaller, turbinal process above the middle concha, and above this usually at least one, sometimes two, smaller bony turbinal folds. All these structures are lined with mucous membrane.

The narrow chink between the nasal septum and the

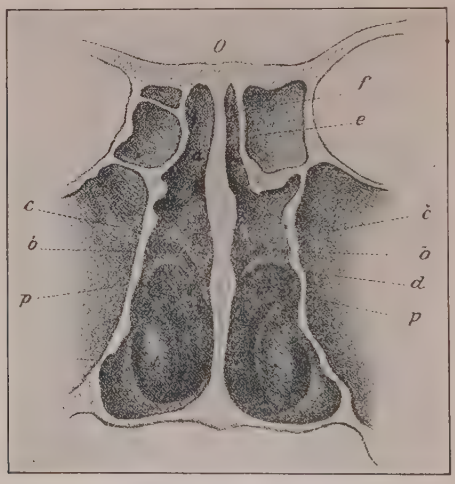



FIG. 6.—Frontal section through the rear part of the nasal passages, showing the anterior surface of the sphenoid. Through the posterior choanæ a view is had of the nasopharynx: *O*, Roof; *a*, anterior surface of the sphenoid bone; *b*, *b́*, depression between the anterior and posterior folds of the upper nasal wall; *c*, *c*, anterior fold, *d*, posterior fold, of the upper nasal wall; *e*, spheno-ethmoid recess; *f*, orifice of sphenoid sinus; *t*, Eustachian prominence; *p*, *p*, pharyngeal tonsil (Zuckerkandl).

turbinal surfaces above the middle turbinal is the olfactory fissure in which the nerves of smell spread out in the mucous membrane. Between the middle and the upper turbinals and the external wall of the nasal cavity are the ethmoid cells, the spaces confined by the deviated and partially coalesced turbinal processes and accessory septa. These are a series of more or less communicating cells lined by mucous membrane with orifices into the nasal passage (see ¶ 43). Beneath the front end of the

middle turbinal are the openings leading into the frontal and maxillary sinuses. The sphenoid sinus communicates with the nasal space through a slit in the anterior sphenoid wall. The only other channel connected with the nose is the lacrimal duct, which empties under the external side of the inferior turbinal, close to its front end.

The nasal passages connect with the pharynx through the posterior choanæ. These openings, each of oval shape, are separated by the posterior border of the vomer, and are bounded above by the lower surface of the sphenoid ; externally and below, by the palate bones. Their plane is not quite vertical, but slants slightly downward and forward (Fig. 6).

**6.** The **pharynx** may be described as a somewhat flattened tube, increasing in width from above downward, the posterior wall of which curves over to form the half-dome-shaped roof. This roof is level with and continuous with the roof of the nasal chambers. The main tunic of the pharynx is a fascia, the shape of which is best described by its attachments. The periosteum lining the inferior surface of the occipital bone is thickened in the form of a firm plate, termed basilar fibrocartilage. From this fibrocartilage, and as a part of it, the pharyngeal fascia extends downward, being fastened to the slightly protruding body of the atlas, while below the atlas it is separated from the vertebral bodies by loose areolar tissue. Laterally, the curve of the pharyngeal roof extends over to the edge of the inferior surface of the petrous pyramids of the temporal bones, to which the fascia is fastened, and from which it descends. In front the fascia gliding over the short exposed (rear) area of the lower sphenoid surface adheres firmly to the bony rim of the choanæ, and thence passes transversely to the inferior maxilla, where it ends anteriorly. The sides and posterior wall of the pharynx are completely surrounded by the fascia, which thence continues downward as a lamella of the cervical fascia. The pharynx

proper ends at the level between the fifth and the sixth cervical vertebra. The pharyngeal fascia is lined throughout with mucous membrane, and is surrounded below the atlas by the constrictor muscles of the pharynx.

From the foregoing description it is apparent that the pharynx has no real anterior wall. Below its roof are the nasal openings. Between the nasal passages and the cavity of the mouth is the bony palate, the plane of which is prolonged by the soft palate. The latter is a muscular diaphragm lined by nasal mucous membrane on its upper, and by buccal mucous membrane on its under surface. The muscular fibers converge into the palate from the base of the skull, rim of the choanæ, and pharyngeal walls, and end in a tendinous aponeurosis inserted into the rear border of the bony palate. The free posterior border of the soft palate is concave, but with a pendant tongue-shaped prolongation from its center—the uvula. Inspection shows that on each side of the uvula there arises a fold or ridge in the mucous membrane of the palate, parallel with the posterior free border, running transversely to the insertion of the palate at the roof of the mouth. There the posterior palatal border continues downward in the form of another fold of mucous membrane running down and somewhat backward,—the posterior pillar of the fauces,—while the aforesaid palatal ridge descends on the side of the mouth as the anterior pillar down to the root of the tongue. By the divergence of the pillars a niche is formed for the tonsil. During the act of swallowing and gagging the faucial pillars protrude in the form of a well-defined septa under the constricting influence of the muscles external to the mucous membrane. During such movements the palate is stretched tense and maintained in the horizontal plane, so as to separate the nasal from the oral part of the pharynx. When relaxed, however, during rest, the rear part of the palate curves downward.

In the triangular niche between the faucial pillars, normally quite shallow, lies the **tonsil**. The normal tonsil

is a thin cushion of adenoid tissue in the substance of the mucous membrane. In our climate it is more often seen morbidly enlarged than normal. Across the base of the tongue there stretches a bridge of adenoid tissue from one tonsil to the other—the **lingual tonsil.** The (incomplete) ring of lymphatic tissue in the pharynx surrounding the buccal opening is completed by a cushion of adenoid tissue in the mucous membrane at the roof, immediately behind the choanæ—the **pharyngeal tonsil.**

The cartilaginous portion of the **Eustachian tubes** lies underneath the lateral walls of the pharynx, outside of the fascia. As these tubes expand in passing forward, downward, and slightly inward, the side of the pharynx is made to bulge inward in the form of a flattened elevation. In front of this tumefaction, at the level and back of the end of the inferior turbinal, is the Eustachian orifice. By reason of the divergence of the anterior and posterior lips of the Eustachian orifice the pharyngeal end of the tube appears as an irregular triangle of a yellowish-white color. The (variable) prominence of the Eustachian tube forms a recess at what might be called the junction of the lateral wall of the pharynx with the superoposterior wall—the **fossa of Rosenmuller.** This recess becomes shallower downward and ceases just above the level of the palate.

The caliber of the pharynx is, of course, influenced by movements of the head. When the head is inclined backward, the distance between the palate and posterior wall is lengthened, whereas by depression of the head it is shortened. When the head is turned to the side by rotation upon the axis (second vertebra), torsion of the pharynx, which is observable through the mouth, results.

**7. The Membranous Lining of the Respiratory Passage.**—The entire respiratory passage is lined by a continuous mucous membrane, which extends into all communicating passages and sinuses. In the nose it is thickest over the inferior turbinal, becoming thinner in the higher regions and still more reduced in the pneumatic cells and

accessory sinuses. Close examination shows a somewhat uneven surface of the nasal mucous membrane, with minute ridges and furrows and miniature wart-like elevations. This unevenness of the surface is often grossly exaggerated in inflammatory hypertrophy. In the pharynx the mucous membrane is smoother but thicker; it is especially massive, however, where it is infiltrated with adenoid tissue so as to form the different tonsils. In the nose and accessory cavities the mucous membrane is inseparable from the periosteum. The transition from skin to mucous membrane begins at about the level of the projecting fold in the vestibule. Beyond this threshold, throughout the nose and pharynx, the membrane contains an abundance of branched tubular mucous glands; in the nasal sinuses, however, the glands are few in number. The surface epithelium consists of stratified cylindric cells, of which those on the free surface are ciliated. Interspersed are mucus-forming "beaker cells." In the pharynx, at about the level of the second vertebra, the epithelium changes into stratified pavement epithelium. The epithelial cells in the interior of the mucous glands are cuboid.

In the upper nasal region, which contains the nerves of smell, the structure of the lining membrane, and also of its epithelium, is peculiar. This area extends over the nasal surfaces above the middle turbinal and anterior to the sphenoid sinus, both on the septum and on the surface of the upper turbinal processes. Here the epithelial cells form large cylinders, not ciliated in the ordinary sense, but presenting a few coarse, hair-like "cilia," non-motile, but presumably the specific end-organs of the olfactory nerve.

Underneath the epithelium there is a well-defined structureless basement membrane, with a multitude of tubular perforations, which are probably the inlets (or outlets?) of the lymphatic system. The substance of the mucous membrane consists of a connective-tissue stroma with elastic fibers. Both connective-tissue and elastic

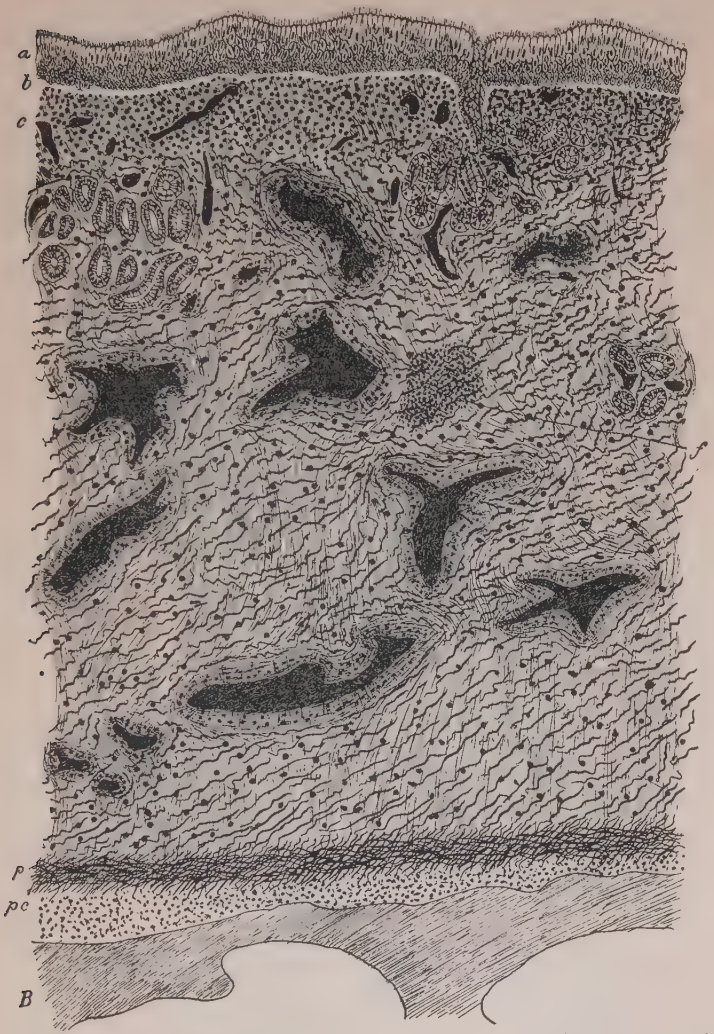



FIG. 7.—Histologic structure of the mucous membrane over the inferior turbinal: *a*, Ciliated cylindric epithelium; *b*, basement membrane; *c*, adenoid layer; *f*, follicle; *p*, elastic layer of periosteum; *pc*, cellular layer of periosteum; *B*, bone.

fibers are more or less continuous with the periosteum over the bony walls, with the perichondrium over the cartilaginous part of the septum, and with the pharyn-

geal fascia. Where the surface is plane in the nose the mucous membrane is easily detached, but wherever there are bony crests or sharp angles it adheres firmly to the underlying structure, as it does also in the entire pharynx. Along the turbinals, most noticeably the middle turbinal, the stroma dips into the smaller cellular spaces of the spongy bone and assumes a medullary structure with the presence of fat-cells. All larger bone-cells, however, are lined by very thin mucous membrane and epithelium.

Underneath the epithelium the stroma presents a uniform infiltration with lymphoid cells throughout its entire extent. These round cells are migratory, and are found penetrating into the epithelial layer. This is particularly the case in the region of the pharyngeal tonsil, where the epithelium is crowded with lymph-cells. The tonsils themselves (pharyngeal, faucial, and lingual) consist of lymphoid cells arranged in the form of follicles, with incomplete connective-tissue capsules in the substance of the mucous membrane.

**8. The Vascular Supply of the Upper Respiratory Tract.**—The whole lining of the respiratory tract is exceedingly vascular. The capillaries are arranged in three layers—a deep stratum close to the periosteum, a coil of capillaries around the glands, and an extensive network in the superficial adenoid stratum. Most peculiar, however, is the arrangement of the veins. Throughout the entire mucous membrane there is a dense network of veins with small meshes, the caliber of the vessels increasing in proportion to the distance of the vessels from the surface. The thickness of the mucous membrane depends largely on the development of the venous plexus. In several areas in the nose—viz., at the anterior end of the inferior turbinal, along the margin of the middle turbinal, at the rear ends of both inferior and middle turbinals, and to a less extent over the tuberculum of the septum—the venous plexus changes into true cavernous tissue. The vessels are relatively large, compared with the inter-

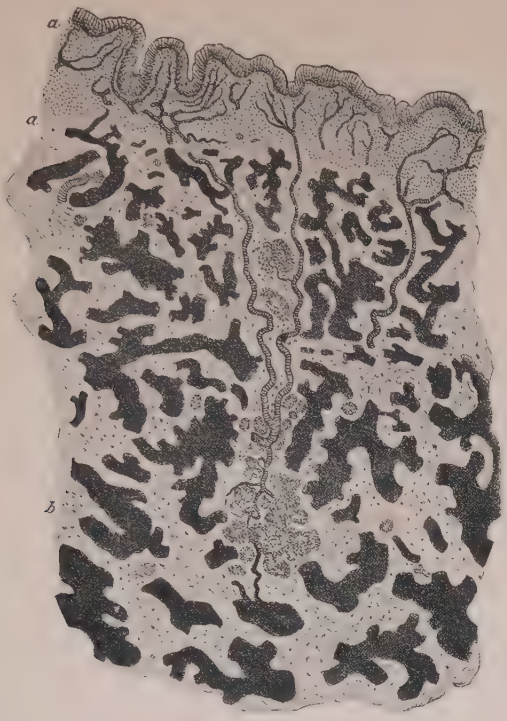



FIG. 8.—Cross-section through the mucous membrane of inferior turbinal (posterior end) (Hartnack Obj. 4, Oc. 2). The glandular vessels in exaggerated magnification: *a*, *a*, Subepithelial layer with cortical vessels; *b*, the lacunar part of the cavernous body with arteries verging toward the subepithelial layer (Zuckerkandl).

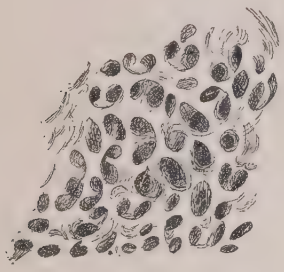


FIG. 9.—Cavernous tissue of the inferior turbinal after removing the superficial layer of mucous membrane. The interior of the vessels is shaded (Zuckerkandl).

FIG. 10.—Cast of the venous plexus over the inferior turbinal: corrosion specimen (Zuckerkandl).

spaces between them; but, on the other hand, they are individually short, on account of their fusion to form a network, and they present an enormous development of the muscular tunic not found in ordinary veins. When not artificially injected, these veins show an irregular puckered cross-section. The density of the venous network can be observed best in a corrosion specimen. These veins are fed only through the capillaries, and do not communicate directly with arteries. The thickness of the mucous membrane changes within wide limits, according to the degree of turgescence or collapse of the cavernous plexus.

The efferent veins of the nose are not large, but they are numerous. They emerge partly into the orbit through the ethmoid plate, into the cranial cavity, into the palate, and to some extent into the sides of the pharynx. Larger veins form a plexus around the pharynx external to the mucous membrane, and empty into the internal jugular vein.

The arteries of the nose and pharynx are likewise not large. The sphenopalatine artery, a branch of the internal maxillary, supplies the nose from the rear, emerging from the sphenopalatine fossa, and sends branches to both external wall and septum. A collateral supply is likewise obtained from the ethmoid and external nasal arteries.

The pharynx derives its blood supply mainly from the ascending pharyngeal artery, which ascends along, but outside of, the lateral pharyngeal wall, enters at the roof, and sends branches in all directions. There is, besides, free communication with all adjoining arteries. The internal carotid artery and internal jugular vein run parallel to the lateral pharyngeal wall, but are separated from the pharyngeal fascia by a layer of loose areolar tissue over a centimeter in width. Hence they are not endangered by ordinary pharyngeal operations.

The lymph-vessels form a close network in the substance of the mucous membrane, and empty through

channels in the soft palate and pharyngeal walls into the cervical lymph-passages and glands. In animals a communication has been shown between the subarachnoid spaces and the nasal lymph-channels. In man this connection has not been demonstrated. Injection of the lymph-vessels allows the fluid to escape through the tubular perforations in the basement membrane into the epithelial layer, even up to the free surface.

**9. The Nerve Supply of the Upper Respiratory Tract.**—The specific nerve of smell is the olfactory nerve, which sends its branches through perforations in the lamina cribrosa in two rows, of which the inner row descends along the septum, whereas the outer spreads over the external wall as far as the attachment of the middle turbinal. The nerves of ordinary sensation of the nose are branches of the fifth nerve. The embryonic formation of the septum—and, to a certain extent, of the nasal walls—from two distinct areas of development accounts for the peculiar double supply of nerve-fibers. A branch of the first division of the fifth nerve—the ethmoid—enters the nose through the ethmoid canal and supplies the anterior area of the septum and the external wall. The entire rear region, however, derives its fibers—the postnasal nerves—from the second division of the trigeminus. These fibers, coming from Meckel's ganglion, enter above and posteriorly from the sphenopalatine fossa. The pharynx receives its sensory fibers from the pharyngeal plexus, which is made up of branches from the vagus, spinal accessory, and glossopharyngeal nerves. This plexus supplies also motor nerves to the pharyngeal and palatal muscles, except the tensor palati muscle, which is innervated by the internal pterygoid branch of the trigeminus. The muscles of the external nose, which dilate the nostrils, are under the control of the facial nerve.

**10. Physiology of the Upper Respiratory Passages.**—The nasal passage fulfils a double purpose. It contains the organ of smell, and it serves as the main channel for

the entrance and exit of air in breathing. The olfactory nerve-ends ramify over a much smaller area in man than in most of the lower animals, and the sense of smell is correspondingly less highly developed and of smaller importance in man. The olfactory area in the human being is limited to the surface of the septum and the external wall, above the middle turbinal and anterior to the sphenoid bone. The current of air bearing odoriferous particles or vapor enters the narrow olfactory chink during ordinary inspiration, but it is directed thither more forcibly during sniffling,—short, abruptly ending inspirations,—which creates eddies in the intranasal air-current and thus favors diffusion. The expired air does not enter the olfactory fissure on account of the configuration of the posterior choanæ. For this reason odors arising from the presence of decomposed secretions in the throat and nose are not perceptible to the patient himself. Inflammatory swelling leads readily to occlusion of the olfactory chink, thereby abolishing the sense of smell temporarily. To what extent the nerves of smell and their terminal epithelia suffer permanently in various nasal diseases has never been determined.

By reason of the shape of the vestibule, the current of air during inspiration is directed somewhat upward, and describes a curved path mainly through the middle meatus to the posterior choanæ. Eddies are produced in the air-current on account of the various irregularities of the intranasal surfaces, and this rotary motion favors permeation of all recesses by the moving air. In its passage through the nose the air undergoes three changes: It is warmed nearly to the body-temperature, is saturated with aqueous vapor, and is partially freed from dust. This influence upon the inspired air is due to the large expanse of nasal surface and its high degree of vascularity. The absolute amount of warmth imparted to the air depends, of course, upon its previous temperature. The quantity of moisture lost by the nose varies likewise with the atmospheric conditions. The saturation of the inspired

relatively dry air of a winter's day requires about 30 grams of water an hour. This high figure would naturally be much reduced on warm days or in moist weather. The deposition of dust is favored, no doubt, by the vestibular hairs, but depends mostly on the convolutions of the moist surface over which it passes. This clearing of the air is not, however, absolute, and the filtering mechanism proves insufficient when the air is unusually dusty. The deposited dust containing living germs is expelled from the nose by the pushing motion of the epithelial cilia, which wave in the direction toward the anterior nares. Experimentation has shown that in spite of the microscopic dimensions, the energy of the ciliary motion is quite considerable, on account of the rapidity of the vibrations. Various observers have found that the internasal surfaces harbor remarkably few bacteria, although every breath of air deposits its living dust. It has been claimed, but has not been definitely proved, that the nasal mucus possesses some bactericidal properties. The surface, to the depth of the cilia on the epithelial cells, is continuously bathed by a layer of mucus, but during health there is never sufficient secretion to flow along or accumulate on the surface except momentarily in response to irritation. This statement applies equally to the pharyngeal lining.

Narrowness of one side of the nose does not interfere with ordinary breathing if compensated for by sufficient width of the other side. It makes the subject, however, short-winded on exertion. But if both nasal passages are insufficient, a reflex mechanism enforces opening of the mouth and mouth-breathing results. In its passage through the mouth the air is not warmed, moistened, nor clarified to the same extent as occurs in nasal breathing. Although it cannot be said that cool, relatively dry or dusty air is directly a cause of disease of the lower air-passages, it undoubtedly exercises an unfavorable effect that may aid other disease-producing influences. In nurslings the mechanism of mouth-

breathing is not yet fully established, and hence nasal obstruction is more distressing to them, especially during nursing.

The soft palate acts as a triple valve between nose, pharynx, and mouth. When its muscles are at rest there is free communication between these three spaces. During the act of swallowing—likewise gagging and retching—the nasal part of the pharynx is shut off from the lower region. The palate is stretched horizontally and is tense, the posterior pillars are changed into projecting septa applied against the posterior wall, while the constrictor muscles of the pharynx narrow its caliber and cause its posterior wall to touch the edge of the palate. When this mechanism is viewed from above through the nasal passage, widened by any destructive disease, the pharyngeal wall appears constricted in a ridge meeting the elevated palate. This protrusion, due to the action of the constrictor muscles, is known as Passavant's ridge. Incidentally the levator and tensor palati muscles cause the Eustachian orifice to gape during their contraction in swallowing. When the palatal muscles are paralyzed, as in postdiphtheritic paralysis, the closure of the nasopharynx is incomplete and food and fluids find their way into the nose. If nasal breathing is to continue while the mouth is open, the air is kept out of the mouth by elevation of the base of the tongue, while slight tension of the muscular fibers in the anterior faucial pillars pulls the pendant palate against the tongue.

During speech the palate is in a variable state of activity. Pure vowels are produced only when the air passes through the mouth and the palate is partially raised. If a part of the air passes into the nose, the vowel has a nasal twang. The most pronounced nasal sound, "ng," occurs during absolute relaxation of the palate. The position of the palate varies with the different consonants. A very sensitive test to detect the passage of air through the nose during intonation is

furnished by a cold mirror held in front of the nostril, upon which the expired air will deposit its moisture.

**11.** The nasal membrane is very sensitive to touch, although deep incisions produce only moderate pain. The nasal sensitiveness resists anesthetics to such an extent that tickling of the inside of the nose with a feather is sometimes of service in impending failure of respiration during narcosis. Nasal irritation, mechanical or chemical, results in sneezing and the free flow of a thin, mucous secretion. The surface of the pharynx is less acutely sensitive than the nasal lining, and its mechanical irritation distresses mainly by reason of the reflex retching movements that it calls forth. Mucous secretion from the pharynx, brought on by irritation, is more viscid than the nasal fluid.

## CHAPTER II.

### GENERAL ETIOLOGY AND HYGIENE OF NASAL AND PHARYNGEAL DISEASES.

**12. Origin of Nasal and Pharyngeal Diseases.**—Most nasal and pharyngeal affections are of inflammatory origin, being due either to an acute or a chronic inflammatory lesion or to its consequences. Acute coryza, either simple or as part of some infection (influenza, measles), and the residual inflammatory processes that may persist afterward, as well as hypertrophies thus produced, the involvement of the accessory cavities in the course of a coryza or as part of some general affection, and the various forms of inflammation and enlargement of the pharyngeal lymphatic tissue are responsible for most of the complaints referred to the nose and throat. The parasites giving rise to these infections have been only partly identified. The microbe of common coryza has as yet escaped detection, although the history of the disease leaves no reasonable doubt that it is of microbic origin, while its frequency indicates the universal distribution of the virus. It has, likewise, not been fully established to what extent secondary infection with the various familiar pathogenic microbes is responsible for the prolongation of a coryza. In affections of the nasal sinuses the various forms of pyogenic bacteria—staphylococci, streptococci, pneumococci, diphtheria bacilli, colibacilli, and others—have been found. Tonsillitis is due mostly to streptococci, occasionally to other forms. A limited rôle is played by specific infection in the nose and pharynx by the diphtheria bacillus, the bacillus tuberculosis, and the virus of syphilis.

**13. "Colds."**—Of equal, if not of greater, clinical im-

portance than the identification of a parasite is the recognition of the external and internal conditions which favor or even determine infection. Of all influences, that of "taking cold" is most often accused by the layman to be the cause of nasopharyngeal disorders. Indeed, in the mind of the laity the etiologic aspect has been so confounded with the pathology that most nasal and throat diseases are commonly called "cold." This universal belief is supported only to a very limited extent by tangible evidence.

It is a matter of frequent observation that individuals who have chronic affections and structural lesions in the upper air-passages experience at times acute aggravations within from twelve to twenty-four hours after a chilling of part or the whole of the surface of the body. In some instances it is prolonged chilling of the feet; in others, the exposure of the head and shoulders to a draft, especially when these parts were previously warm. Sometimes, perhaps less often, it is the cooling of the entire skin which apparently leads to an acute intensification or extension of an existing inflammatory process of low grade. The difficulty of investigating these occurrences is very much increased by the fact that such exposure is not always followed by the same results, and that, on the other hand, the history of exposure does not always precede such exacerbations. Yet the significance of exposures of this kind is sometimes demonstrated by the success with which patients evade these "colds" after their attention has been called to the necessity for better protection. Strongly suggestive, too, of the reality of "taking cold" is the common experience that these aggravations are least likely to occur under conditions of equable weather—for instance, in midsummer. It is not, however, the constant cold of winter that experience has shown to exert the most marked influence, but, rather, the sudden thermometric changes in fall and spring, especially when combined with humidity and chilling winds. In this connection it is of interest to remember

that various arctic explorers (Nordenskjold and Nansen) have spoken of the noteworthy exemption of their crews from "colds" while wintering in the far north.

All these observations confirm the view that chilling of the skin can play an important rôle in intensifying nasal and pharyngeal inflammations and causing their extension—at least when combined with other influences the nature of which is as yet unknown. Whether, however, the act of "taking cold" can give rise to an inflammation in a nose or throat hitherto entirely normal is an undecided problem. In most cases that belong to this category a history of exposure cannot be obtained with the definiteness requisite for scientific reasoning. Yet the seasonable distribution of fresh attacks of coryza and of tonsillitis lends some color to the view that they, too, may result, under some circumstances, from "taking colds."

It is probable that the mechanism of "taking cold" consists, in part, in circulatory disturbances. In persons in whom previous nasal disease has led to enlargement of the cavernous venous tissue the influence of chilling of the warm skin upon the intranasal circulation can be studied advantageously. Under these circumstances exposure immediately gives rise to a turgescence of the nasal mucous membrane, usually with sneezing, and followed by a watery discharge from the nose. As a rule, these disturbances cease in a short time. It probably requires the conjoint influence of other unknown factors, together with chilling, in order to start or extend infection in the nose.

*The Prevention of "Colds."*—In giving advice regarding protection against "taking cold," it is necessary to individualize. Cast-iron rules concerning clothing are neither supported by experience nor are they likely to be accepted by many patients. The most sensible plan is simply to wear comfortable clothing suitable to the time of the year and to be prepared for sudden changes in the weather.

The amount of clothing requisite for this purpose varies with the vigor and habits of the individual. Most persons are apt to be indifferent regarding chilling of the feet; hence advice concerning woolen stockings, heavier shoes, overgaiters, or rubbers is often followed by benefit.

Cold feet are due, in some instances, to the evaporation of a profuse perspiration. This can be controlled effectually and permanently by a single foot-bath of a few minutes' duration in a 5 per cent. solution of chromic acid. On account of the possible poisonous effect of chromic acid upon the kidneys the writer has limited the application to one foot at a time, and has never had any unpleasant results. Formalin in full strength will also control excessive perspiration, but must be used repeatedly at intervals of weeks. When cold feet are due merely to a poor cutaneous circulation, this can be improved satisfactorily by the use of tincture of capsicum as a foot-wash continued for days or weeks. Good results are also obtainable by daily foot-baths, alternating a few times between cold—not cool—and hot water, and finishing with the latter.

*Temperature of Dwellings.*—As the temperature of the interior of houses is not much lower in winter than in summer, it is wiser to adapt one's self for the cold outdoors by wearing changeable outer garments rather than by an excessive quantity of underclothing. Muffling of the neck is often found to increase the liability to "colds."

So far as it is possible, attempts should also be made to regulate the temperature of the interior of dwellings, avoiding both extremes,—excessive heat and unpleasantly low temperatures,—and giving due regard to ventilation. An unbiased observer can hardly escape the conclusion that the popular fear of drafts does more damage to the general health, by causing people to live and sleep in a vitiated atmosphere, than an indifference to drafts would do, even if it be responsible for an occasional

"cold." Much of the fear expressed by various writers regarding the dangers due to the dryness of the air caused by artificial heating, especially by steam, in winter, is based on speculative reasoning only. Most of the Western States, especially the mountain regions, have a very low relative humidity, while their climate is universally acknowledged to be very "healthful." The compensatory ability of the organism is such that it can adapt itself to wide variations in the surrounding physical conditions.

There can be little doubt that the ability to resist unfavorable meteorologic influences depends largely on the individual's habits and training. Restrictive anxiety, especially when it interferes with an outdoor life in the rearing of children, is probably more disastrous than negligence in the other direction.

*Cold baths* and *cold sponging* are recommended highly by text-books as preventives against "colds." A fairly large experience, started originally with some enthusiasm, leads the writer to believe that the efficiency of this measure is somewhat overrated as regards its influence upon the resisting power of the respiratory passages. Yet he would heartily recommend a daily cold plunge for its general tonic effect, provided it be followed by a comfortable reaction and a feeling of warmth. In anemic and neurasthenic conditions this reaction is sometimes not obtainable. It is more likely to follow a quick cold plunge than a cool bath or the mere sponging of the skin. Diseases and chronic lesions of the upper respiratory passages need not interfere with baths of any kind. Baelz, with sixteen years' medical experience in Tokio, states that the Japanese take one or more baths daily at from 42° to 44° C., many of them passing at once into the streets, thinly clad, even in cool weather. Experience has not shown that "colds" result from this practice. It is also well known that the change from the hot steam room to the cold plunge in Russian baths is not ordinarily followed by unpleasant consequences.

**14. The Influence of Climate on Diseases of the Upper Air-passages.**—Regarding the influence of climate upon affections of the air-passages, there is as yet but little precise knowledge. The best known instance of the influence of climate on disease is shown by the immunity of certain localities to hay-fever. These are partly mountain resorts, partly the shores of various bodies of water. This disease, which is not an inflammatory process, but essentially a nervous disturbance, is promptly arrested when the sufferer arrives in these exempt localities. Common to them all is the relative absence of dust. Many other dust-free localities do not, however, grant similar immunity. A definite climatic influence can also be observed with regard to the nervous symptoms and disturbances that are often caused by "perennial" turgescence of cavernous tissue in the nose—sneezing fits, asthma, headache, etc. They are promptly relieved on reaching moderate altitudes in the mountains, and, as a rule, are permanently benefited by a sojourn in such localities. Apart from these two instances, there is much diversity of opinion regarding the effects of climate upon the nose and throat. The author's impressions, based upon the histories of traveling patients or those who have permanently changed their residence, and upon discussion with physicians in different parts of the country, as well as upon some personal traveling experiences, may be stated in this manner: Acute attacks and acute inflammatory exacerbations occur most frequently where there are sudden changes in temperature, prolonged spells of wet and cold weather, and irregular winds. On the other hand, they are least likely to occur where the temperature is equable, especially when there are no prolonged spells of high atmospheric humidity, and where the winds, even if intense, occur with a certain regularity. All these hygienic conditions exist more on the western than on the eastern side of the Rocky Mountains, and especially in the Southwestern States. Since all chronic lesions in

the nose and pharynx are, as a rule, aggravated by acute exacerbations, a residence in the Western States, and especially in the southwestern parts (California, Arizona, New Mexico, Southern Utah), is less likely to intensify or maintain nasal disturbances than living in the Middle or Eastern States. Moreover, as irritative symptoms (sneezing, asthma, etc.) are usually promptly relieved by the western climate, especially at moderate altitudes, excepting in dusty regions, patients often experience much benefit from a trip to these parts of the country. Regarding its influence upon inflamed nasal passages, Colorado is not praised by its own physicians, but, in the author's experience, his patients have usually been benefited by its dryness and sunshine. Regarding the Southern States east of the Rocky Mountains his own impressions have been much less favorable. There are, however, many chronic conditions, such as deep-seated suppurative foci and hypertrophic lesions, that will not disappear under climatic influences alone, although the subjective annoyance produced by them is reduced by favorable climatic environment.

**15. Factors in the Etiology of Diseases of the Upper Respiratory Organs.**—Of great etiologic importance in the pathology of the upper air-passages are the **anatomic configuration** and the **changes resulting from previous disease.** It can be readily observed clinically that both suppurative and hypertrophic processes occur predominantly in narrow nasal passages, narrow either from pronounced relative narrowness of the skull or encroachment of the external nasal wall upon the caliber. Wide passages, on the other hand, appear in the minority in nasal affections, except in ozena, to which they predispose. Even more important are circumscribed encroachments upon the caliber of the passages, such as deflections of the septum, crests upon the septum, hypertrophies of mucous membrane, and enlargement of the pharyngeal lymphatic tissue. Hypertrophic processes accompanied by inflammation thus tend to perpetuation, by reason of the vicious

circle to which they give rise. In one-sided nasal stenosis it is especially noticeable that any acute and ordinarily transient inflammation is likely to become persistent on the narrower side of the nose, or to extend to the ear of that side. Striking, too, is the diminished liability to acute "colds" after a properly indicated removal of a pharyngeal tonsil, a successful septum operation, or cauterization of redundant tissue. There are, moreover, some inflammatory processes, which, even though they seem to have healed entirely, as judged by clinical evidence, create a disposition to their own recurrence, such as acute inflammation of the frontal sinus, and especially tonsillitis. Hence the surgical treatment of existing chronic lesions, even when they cause but little discomfort, plays an important rôle in the prophylaxis of nasopharyngeal affections.

The liability to structural changes depends often on **hereditary peculiarities.** Enlargement of the pharyngeal tonsils is strikingly frequent in some families; in others, it is totally absent.

**16.** Although most of the diseases of the nose and pharynx are strictly localized processes, their occurrence and persistence are in some instances more or less dependent upon **morbid conditions elsewhere in the body.** A specialist can never afford to lose his interest in general pathology.

The liability to "colds" is increased by **anemia** and other conditions of **malnutrition,** and diminishes again with returning systemic vigor. Of acute infections of the accessory sinuses, the majority are incident in the course of **infectious diseases,** as shown by autopsies. While most of the sinus involvements under these circumstances present but few clinical symptoms, yet a small number turn into chronic and persistent forms. In affections of the maxillary sinus the origin must be sought in **carious teeth** in a moderate proportion of cases.

Inflammatory processes in nose and throat are also largely influenced by **disturbances of the digestive system.**

The various forms of dyspepsia, and especially constipation, are often a serious obstacle in the treatment of diseased air-passages, and proper attention to diet and the function of the bowels is not rarely the first step in the road to success. In chronic constipation which does not yield to fruit and exercise, enemata of hot water prove more serviceable in the end than the habitual use of laxatives.

The discomfort due to a given degree of nasal disease is to some extent an index of the **condition of the nervous system**. Thus, for instance, chronic suppuration of the accessory cavities need not give rise to much actual suffering in subjects with vigorous nervous system, whereas in neurasthenic conditions such processes may cause considerable pain in the form of headache and neuralgia. The tone of the nervous system is also indicated strikingly by the vascular irritability in the nose and the so-called reflex disturbances thereby engendered in those cases in which there is enlargement of the cavernous plexus in the nasal lining. Thus it is not uncommon to see these disturbances intensified during pregnancy. In such instances more can often be accomplished therapeutically by advice from the standpoint of the neurologist than by treatment limited to the nose, although, of course, both lines of therapeutics should be considered.

17. From an etiologic point of view the **habits of the individual** must not be ignored. It can be readily observed that smoking tobacco irritates and increases the secretion in affections of the posterior parts of the nose and of the throat. The difference is promptly noticeable if the patient reduces his allowance of tobacco, especially if this is used in the form of cigarettes. If he can restrict himself within the limits of two or three cigars daily, or their equivalent in the pipe, it is generally unnecessary to insist on total abstinence. There is, however, one form of pharyngeal disease in the etiology of which smoking plays a greater rôle than in any other affection. It is the diffuse chronic pharyngitis, usually dependent, in

the first place, upon nasal stenosis or nasal suppuration, and characterized by thickening and uniform injection of the pharyngeal wall, and especially its adenoid elements, the tonsils and strands of lymphatic tissue behind the posterior pillars. In this form the throat is very sensitive to mechanical contact. According to personal experience, this form of pharyngitis occurs mainly—though not quite exclusively—in smokers, and necessitates total abstinence for relief. Alcoholic excesses, too, may have some share in the etiology of this pharyngitis. The morning vomiting of hard drinkers is often dependent on this diffuse pharyngitis; sometimes, however, it is due to chronic inflammation of the lingual tonsil. Attention has also been called to the injurious influence that the drinking of very hot fluids may exert upon the pharynx.

Inflammatory disease of the upper air-passages is also engendered and maintained by **exposure to irritating dust and acrid gases.** Workmen employed in lime, cement, arsenic, and especially chrome works frequently suffer from ulceration of the nasal septum.

**18. Age** is an important factor in the predisposition to different ailments of the upper respiratory passages. Although all ages are equally liable to acute coryza as well as chronic purulent rhinitis, suppuration of the sinuses is rarely seen clinically in young children, and, indeed, not often under the age of puberty, although anatomically it has been demonstrated frequently in connection with infectious diseases of the upper air-passages. The accessory cavities are but poorly developed until after the seventh year. Septum deformities, too, are uncommon in childhood, especially crests and spurs, while deflections may occur before the second dentition, although they are infrequent. Hypertrophies of the nasal mucous membrane, in particular polypi, are rare lesions in childhood. This is one of the reasons why children are almost exempt from postnasal catarrh. Atrophic rhinitis (ozena), on the contrary, usually begins early in life.

The lymphatic structures in the pharynx do not grow

morbidly after the first three or four years of life, unless hypertrophy had begun previous to that time. After puberty the morbidly enlarged tonsils, especially the pharyngeal tonsil, may recede moderately. When enlarged, they give rise to more annoyance during childhood than in later life, partly because pharyngeal and tonsillar inflammations are more especially an ailment of childhood and adolescence, and, in part, because the lymphatic structures become more fibrous and less vascular in the course of years. Infectious diseases localized in or involving the upper air-passages, such as diphtheria and the eruptive fevers, become less and less common as early childhood is passed.

## CHAPTER III.

### SYMPTOMATOLOGY; METHODS OF EXAMINATION AND APPEARANCES OF NOSE AND PHARYNX; METHODS OF TREATMENT IN NASAL AND PHARYNGEAL AFFECTIONS.

**19. Subjective Symptoms.—Pain.**—Most nasal diseases do not cause pain. Abscess of the septum and gummatous tumors under the periosteum may, however, give rise to severe suffering, the pain not being correctly localized, but described as headache. In neurasthenic persons various nasal diseases may be attended with much discomfort, especially in the form of diffuse headache, while neuralgia of the supra-orbital or infra-orbital nerves, sometimes of great severity, can be caused by inflammation of the accessory sinuses. Acute inflammation of any of the structures in the pharynx is always painful, particularly during swallowing, and to a degree commensurate with the intensity of the disease. If the upper part of the faucial tonsil or the recess behind the posterior pillar of the fauces is involved, the pain is said to shoot into the ear. In chronic pharyngeal inflammations patients describe the sensation less as pain, but rather as an irritation or tickling.

**20.** The most common complaint of patients with nasal disease is **obstruction of the nasal passage.** This may be present at all times—if due to a structural narrowing of the nasal caliber—or transient, if caused by temporary distention of the vascular plexus in the mucous membrane or by the presence of viscid secretion. The stuffy feeling may be limited to one side of the nose or may exist on both, while if due to excessive vascularity, it often passes abruptly from one side to the other. Nasal obstruction is also very characteristic of any encroach-

ment upon the capacity of the vault of the pharynx by enlargement of the pharyngeal tonsil or by a retropharyngeal abscess, even if the nasal passages themselves are clear. This obstruction, too, is intensified when the vascularity is increased by the reclining position. Hence during sleep mouth-breathing occurs, even if nasal respiration is possible during waking hours. Whenever the tongue is arched during mouth-breathing so as to leave merely a narrow passage between itself and the soft palate, the current of air starts vibration of the soft palate and causes snoring.

The patency of the nasal passages can be gauged objectively by the sound produced by breathing. The air passes through a normal nose both during inspiration and expiration without any sound whatever, except when a most forcible effort is made. In proportion to the narrowness of the passage breathing yields a rustling or whistling noise. In order to test one side at a time the other side of the nose must be closed with the thumb without pressure on the flexible septum.

Interference with nasal respiration is also indicated by the nasal "twang" of the voice. The voice is not affected by a one-sided obstruction if the other side is entirely clear, but whenever both halves of the nose are narrowed, the normal resonance of speech is changed and the voice sounds "dead." The most characteristic change in the voice is found with enlarged pharyngeal tonsil.

**21. Nasal Secretions.**—In the normal condition the nasal mucus is never secreted in sufficient quantity to require removal either by blowing the nose or by aspiration into the pharynx. Hence whenever there is any discharge from the nose it is an abnormal occurrence. The discharge is glairy, clear mucus if due to mechanical or chemical irritation of a non-inflamed mucous membrane, but more or less turbid, or pure pus, if caused by inflammation. The secretion from the rear third of the nasal passage is blown out only with difficulty, but either

drops into the pharynx from time to time, or is drawn back by forcible inspiration. Discharge from the nasal sinuses may also drop into the throat under some circumstances, especially in the recumbent position. If scant nasal discharge dries in the form of crusts, the patients will sometimes remove them only at long intervals. If inspection does not satisfy the surgeon as to the kind or quantity of discharge, the douche can be used (see ¶ 25), whereupon any nasal secretion can be seen floating in the basin.

Purulent nasal secretion has a pronounced odor only if pent up and decomposed or dried in the form of crusts. The two most characteristic odors are those of ozena and of syphilitic necrosis, which may enable an expert to make a diagnosis. Foul, too, but different is the odor in sinus suppuration with retained pus and in concretions and foreign bodies. In any form of nasal obstruction with secretion the breath through the mouth is likely to be offensive, especially on awakening.

**22. Sneezing** is a normal reflex action whenever the nasal lining is irritated. It is a prominent symptom during acute nasal catarrh so long as the nose is not entirely occluded. In chronic nasal diseases sneezing, sometimes in uncontrollable fits, is an annoying feature in proportion to the "nervous" disposition of the patient. It occurs least whenever the mucous membrane is either much hypertrophied or atrophied.

**Coughing** is not, as a rule, produced by nasal disease, but may accompany pharyngeal lesions, especially hypertrophy of the adenoid tissue at the root of the tongue. The cough of pharyngeal patients is, however, commonly due to extension of the disease into some of the structures of the larynx or to coexisting bronchitis.

**23. Methods of Examination of the Nose.**—The objective examination begins with the external shape of the nose. A flattened bridge is often seen in patients with ozena. Decided sinking in of the bridge of the nose is due to cicatricial shrinkage of the septum, almost always

the result of syphilis, either acquired or inherited. Deflection of the nose to one side indicates asymmetry of the septum, caused either by unequal growth or by an injury. On watching the alæ nasi during forcible inspiration it is to be noted whether they remain normally rigid or collapse and are drawn in with every breath, thereby indicating obstruction.

In order to see the interior of the nose light must be thrown in. This is done with a concave mirror with a central perforation through which the surgeon looks. The mirror is held in the hand or is attached by means of a ball-and-socket joint to a strap around the forehead or to a metallic spring clasping the head. There are some handles made that may be held between the teeth. The source of light should be the strongest one available. Sunlight can be used advantageously, with a plane mirror in summer to avoid burning. The light from bright white clouds is perhaps the best of any. A blue sky gives an insufficient light. Of all artificial lights the Welsbach incandescent burner is the whitest, but any gas-jet, preferably an Argand burner, or a broad kerosene flame will answer. Of electric lights, one with spirally wound filament is the best. The various forms of condensers placed in the market offer no practical advantage over the naked flame. If artificial light is used, the eye is more sensitive when daylight is excluded by window-shades.

A very convenient arrangement is an electric headlight, of which various forms are in the market (Fig. 11). A 6 or 8 candle-power miniature lamp inclosed within a tube with condenser lens is attached to the forehead just above the eye. This is connected by means of a flexible and easily detachable cord to the source of electricity. A street current of not over 110 volts is the most convenient source of energy if its intensity is suitably reduced by a proper resistance in the form of a wall-lamp furnished by the maker. An additional device found by the author to be useful is that of putting a

resistance (a lamp of 210 ohms) into the same circuit as a (parallel) shunt, whereby the shock felt by the hand when the exposed metallic connectors are touched is reduced to a minimum. If no street current is available, resort must be had to a battery or a storage-cell, which requires attention and gives rise to some annoyance.

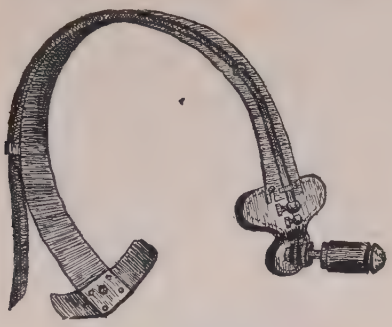


FIG. 11.—Electric head-light.

With the electric head-lamp the observer is more at liberty to move his head than when he reflects the light by means of a mirror.

It is rarely possible to see any distance into a nose without separating the flexible walls of the vestibule by means of a speculum. Additional space is gained by raising the tip of the nose by upward pressure. A bivalve speculum (Fig. 12) can be handled with the least

FIG. 12.—Pynchon's bivalve nasal speculum.

annoyance to the patient, and, on account of the broadness of its blades and the control that the hand can exert over it, it permits the most satisfactory view. It has the disadvantage, however, of not being self-retaining, a requisite in most operations. Of the various spring specula, the author has found Goodwillie's (Fig. 13) and Palmer's

(Fig. 14) the most convenient. Wire specula do not cover the hairs in the vestibule, which, in some cases, interfere with the view and require clipping.

In small children the nose can be viewed through an ear-speculum.

The view into the interior of the nose begins with the vestibule—the space within the external part of the nose. The alæ nasi are lined by true skin with more or less hairs (vibrissæ), whereas on the septum the skin changes into mucous membrane within a few millimeters above its inferior edge and behind its front end. Erosions are sometimes found at the junction of the septum and external nose. The septum is normally straight, but may be deviated morbidly more or less to one side. The lower rim of the triangular cartilage of the side of the nose

FIG. 13.—Goodwillie's nasal speculum.

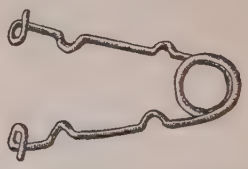


FIG. 14.—Palmer's self-retaining nasal speculum.

projects into the interior of the vestibule in the form of a skin-covered prominent fold narrowing the entrance into the nasal passage (compare Fig. 2).

The nasal cavities proper are the irregularly shaped passages between the nasal septum and the external walls. They begin at the pyriform aperture bounded by the sharp edge of the maxillary bones, and end with the posterior choanæ. Their length varies from 50 to 75 mm. in the adult, the width of the two sides together, measured between the external walls along the floor, from 29 to 42 mm., the total height from floor to roof, from 38 to 50 mm. They are lined by mucous membrane normally of a light grayish-red or pink color.

Each nasal half is bounded on the median side by the septum. When this is perforated pathologically, the view

extends into the other side of the nose. The septum is not, as a rule, an ideal straight wall. In its anterior upper portion the tuberculum of the septum forms a more or less projecting tumefaction. The examiner must note whether any existing projecting irregularities along the septum encroach sensibly upon the nasal caliber or extend even far enough to touch the lateral wall. The surface of the septum may be smooth, and yet, by the convexity of an asymmetric position, the one half of the nose may be narrowed, the other perhaps widened. By successive examinations of the two sides it is ascertained whether an asymmetric septum is merely curved or bent angularly or is absolutely thickened. When the septum

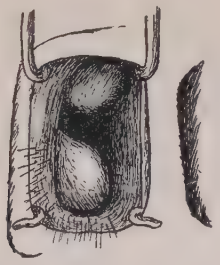


FIG. 15.—View into the normal right nasal passage through the wire speculum, showing the inferior and the front end of the middle turbinal.

is straight, the view extends to the rear, so that with sufficient illumination the posterior wall of the upper pharynx can be seen. The view upward is terminated usually by the narrow chink between the middle turbinated body and the septum. The upper turbinated process is not visible (Fig. 15).

The floor of each nasal passage is smooth, without landmarks. The external wall presents the most varied and variable architecture, on account of its horizontal projecting ledges, the turbinated processes or turbinals. On anterior inspection only the inferior and middle turbinals are visible. The space underneath the former is the inferior meatus; that between inferior and middle turbinal is called the middle meatus of the nose. The

inferior turbinated body forms an overhanging cornice reaching nearly to the floor. Any undue obliquity or projection of this ledge narrows the respiratory passage. Even with normal architecture of the bone the inferior turbinal may obstruct the space by reason of distention of its venous plexus or hypertrophy of its mucous membrane. The swelling, if due to the former condition, can be indented with the probe, but this is not the case if it is dependent on thickening of the mucous membrane. The vascular tumefaction disappears upon the application of cocain, which does not change the appearance of the thickened mucous membrane. In atrophic rhinitis the ledge formed by the inferior turbinal is more or less reduced in size. The space between the inferior and middle turbinated bodies is variable in height.

The middle turbinal is a ledge that, by reason of its curving, hangs down to a variable extent. The distance between the vestibule and the front end of the middle turbinated body is also subject to much variation. Its anterior end is sometimes broadened by expansion of its bony frame.

The mucous membrane covering the middle turbinal is not freely movable, since there exists no well-defined vascular plexus in it. It is only when it is hypertrophied that it can be moved to and fro by the probe. The important space where the maxillary and frontal sinuses communicate with the nasal cavity through openings in the external wall of the nose is completely hidden from view by the middle turbinal. The rear ends of inferior and middle turbinated bodies can generally not be well defined in the anterior rhinoscopic view. The color of the nasal mucous membrane is a pale pink. A red tint indicates inflammation.

If, in a nasal examination, the view is obstructed by general congestion of the mucous membrane or by engorgement of normal or abnormally situated cavernous tissue, a spray of cocain solution, 2 per cent. to 4 per cent. in strength, or of suprarenal solution will cause

sufficient contraction of the blood-vessels to permit a subsequent reexamination at better advantage.

**24. Methods of Examination of the Pharynx.**—While proceeding to the examination of the pharynx the examiner should note the appearance of the mouth. Carious teeth, especially those back of the cuspids, are not a rare cause of suppuration of the maxillary sinus, while sensitive teeth, especially molars or erupting wisdom teeth, may cause neuralgia referred to the ear. Some inference may be made relative to the shape of the nasal fossæ from the shape of the roof of the mouth. An asymmetric palate implies asymmetry of the nasal septum. A high palatal vault is often, but not always, indicative of stenosis of the nasal passages or obstruction of the upper pharynx. Unusual length of the uvula is of significance only if it causes the uvula to rest upon and thereby irritate the root of the tongue. Slight asymmetry of the uvula may be normal, but its adhesion to one side is due to scars following syphilitic ulceration or diphtheria.

Coating of the tongue, if not referable to disease of the teeth or of the stomach or to an acute disturbance, suggests mouth-breathing.

The normal tonsils are practically invisible except on "gagging" or on retraction of the anterior pillar with a blunt hook. They consist of a thin and scarcely projecting layer of adenoid tissue with minute crypts, between the anterior and posterior pillars of the palate. Every visible prominence of this structure means morbid overgrowth Existing inflammation of the tonsillar tissue is shown by any redness differing in hue from that of the adjoining mucous membrane. Within the crypts of the enlarged tonsil there may be concretions that may or may not be visible. If their presence is suspected, they may be squeezed out by pressure with a blunt rod or by inserting a blunt hook into the crypts. From one tonsil to the other there extends a bridge of adenoid tissue along the root of the tongue in front of the epiglottis, called the

fourth or lingual tonsil. It consists of a row of small papules, each about 3 mm. high, with central crypts. The lingual tonsil can be seen only with difficulty by pulling out the tongue, but it can easily be examined by means of the inverted rhinoscopic mirror.

It is often hypertrophied by reason of chronic inflammation, while its pronounced atrophy suggests the existence of old syphilis.

The pharynx may be compared to a somewhat flattened tube, the upper end of which is closed by a half-dome-shaped roof that slopes gradually into the posterior wall. It ends below at the level of the larynx underneath the root of the tongue. Its anterior side is incomplete. Above the palate this is formed by the plane of the posterior choanæ, which plane slopes forward and downward. Underneath the choanæ is the soft palate, forming a horizontal diaphragm anteriorly, but which curves posteriorly, when relaxed, so as to hang down like a curtain. The posterior surface of the pendant portion of the palate thus forms a part of the anterior boundary of the pharynx. Below this is the communication between mouth and pharynx, while the curve of the root of the tongue forms the lowest part of the imaginary anterior wall of the pharynx.

The posterior wall of the lower pharynx is seen only when the tongue is depressed. If the subject cannot do this naturally, the surgeon must use a tongue depressor. This should be of heavy steel, in order not to be bent by an unruly tongue. The simplest shape, two rigid plates at right angles, of which the one for the tongue is perforated to increase its hold, is better than a more complicated instrument (Fig. 16). The examination can be made in a good, direct light opposite a window, or light may be thrown in with the mirror. The more the lips are retracted, the better the view. Turning of the head to either side may simulate asymmetry of the pharynx.

If the person gags during the examination, the tonsils are pushed forward and toward the median line by the

action of the constrictor muscles of the pharynx. During this movement they encroach upon the cavity much more than when in their normal position, and that part of their mass which is ordinarily hidden by the pillars of the fauces is thereby well shown.

The normal pharyngeal surface is a pale pink. Extreme pallor indicates anemia; lividity, on the other hand, suggests venous stasis, possibly due to heart disease. Enlarged veins are the result of chronic irritation, not uncommonly from smoking. Diffuse redness signifies inflammation. In chronic troubles the vascularity may increase during the examination. Red and slightly

FIG. 16.—Bosworth's tongue depressor.

raised follicles of lymphatic tissue are not normal structures, and the same may be said of strands of injected lymphatic tissue at the junction of the posterior and lateral walls of the pharynx. These lateral lymphatic strands are, in rare instances, hypertrophied in the form of projecting wings. The normal pharynx is not covered with secretion. Lumps of mucus or crusts of dried pus are the results of disease, but the lesion is more likely to be in the nasal passage or at the roof of the pharynx than in its lower part.

In order to view the region above the palate a rhinoscopic mirror must be placed behind the posterior pillars of the fauces at such angles that it gives successively

images of the upper part of the pharynx and of the posterior nasal choanæ. The mirror is at once clouded by the moisture of the breath, unless it is either warmed a trifle above the body-temperature or soaped. A film of soap, by itself invisible, remaining after gentle wiping with a cloth, prevents deposition of dew. The mirrors vary in diameter from 1 to 3 cm., and are fastened on the handle at an angle of 45 degrees. The larger the mirror that can be tolerated, the better will be the illumination and the more extensive the view. But it is not possible to see all structures at a single glance with any mirror, and it requires tilting in various directions and shifting of the examiner's head in order to bring them successively into view. As the light is weakened by its double reflection, the examination is more satisfactory the stronger the illumination. Sunlight is by far the best. It is, of course, necessary to throw the light in the direction of the glance through the central hole in the mirror.

An expert can make a satisfactory examination with a rhinoscopic mirror in perhaps one-third of all patients at first trial. A few patients can never be examined—viz., those who oppose the surgeon from fear. This applies to adults as well as to children. The younger the child, the more difficult is it to overcome its fear, but sometimes, even in children as young as three years of age, the roof of the pharynx can be seen fairly well. As soon as the patient fears the instrument he gags and thereby brings the soft palate and the pharyngeal walls into contact, thus rendering the examination impossible. Sometimes this is due to actual irritability of the pharyngeal surface, especially in the chronic inflammation of smokers and drinkers. More commonly, however, the pharyngeal movements are of psychic origin, and can be seen to begin when the mirror is approached and before it touches the mucous membrane. Many patients can be induced to submit by persuasion. Sometimes it requires a few sittings to train them. When the resistance is due to sensitiveness of the pharynx, a 10 per cent. solution of

cocain brushed on the pillars, pharynx, and soft palate may render the examination possible. On account of its unpleasant taste this should not be used needlessly. The view is more sweeping if the soft palate is pulled forward with a palate hook (Fig. 17). If the pharynx is narrow in the anteroposterior direction, the use of the hook may be a necessity. The hook, however, does not reduce the patient's sensitiveness, although it is often as well

FIG. 17.—Tornwald's palate hook.

tolerated as the mirror itself. During gagging the hook affords no assistance to the examiner. For operations a self-retaining palate hook is often serviceable (Fig. 18). Just as serviceable as a palate hook, but also equally as disagreeable, is the retraction of the palate by means of rubber tubing. A drainage-tube 3 or 4 mm. thick and about 30 mm. long is pushed through the nostril and seized in the pharynx with forceps, pulled through the mouth, and its

FIG. 18.—Hoffman's self-retaining palate hook. The elastic traction is made by rubber bands.

ends are tied over the upper lip. Under all circumstances the examination must be made with gentleness, and contact with the mirror with the walls is to be avoided. Like all physical examinations, the use of the rhinoscopic mirror requires much practice before the surgeon can have command of it.

A part of the posterior wall of the nasopharynx and sometimes even its entire extent up to the posterior lip

of the Eustachian orifice is visible to direct inspection without mirror, when the patient throws the head back, while the palate is pulled forward firmly with a palate hook, provided the patient does not gag. The mouth must be opened as wide as possible to permit the surgeon to look up.

In the rhinoscopic image the posterior wall of the pharynx can be traced up to its sloping junction with the roof (Fig. 19). The slope varies in different heads. The transverse width of the pharynx is narrowed above the palate by the projecting lips of the Eustachian tubes,

FIG. 19.—Postrhinoscopic view of the septum, choanæ, Eustachian tubes, soft palate, and pharynx vault.

while above and behind them are the recesses known as the fossæ of Rosenmüller. The more the elevation of the Eustachian tube projects, the deeper are the fossæ. They may be obliterated partly by hypertrophied lymphatic tissue. The vault or roof of the pharynx ends anteriorly at the upper rim of the posterior choanæ. The central area of the upper posterior wall is the site of the pharyngeal tonsil. This cushion of submucous adenoid tissue does not project normally beyond the plane of the surrounding surface. Whenever it forms a distinct tumefaction, it must be called hypertrophied. Its normal

color is slightly redder than that of the posterior wall below it. In children, and somewhat less markedly in normal adults, the pharyngeal tonsil presents from five to seven slightly prominent sagittal ridges. During the earlier stage of morbid hypertrophy this ridged and furrowed appearance is exaggerated in the form of cocks-comb-shaped growth. At a later period the enlarged mass becomes smooth in surface. As the normal tonsil is at least from 5 to 8 mm. behind the rim of the choanæ, the obliquity of the mirror image gives the appearance as if this clear space were a vertical anterior wall above the choanæ, which in reality does not exist. The morbidly enlarged tonsil appears in the mirror at least flush with the rim of the choanæ, but may even hide a large part of the posterior nasal orifice from view. Near the lower or posterior end of the tonsil and in or near the median line there is sometimes seen a small pit—the so-called pharyngeal bursa.

The dimensions of the pharynx are governed by the variable size of the bony rim of the posterior choanæ. Zuckerkandl states this as—

| | In the Adult. | New Born. |
|---|---|---|
| Maximum width of each opening . . . . . | 20 mm. | 7 mm. |
| Minimum width of each opening . . . . . | 13 " | 6 " |
| Maximum height . . . . . | 39 " | 9 " |
| Minimum height . . . . . | 25 " | 7 " |

But as the posterior choanal rim, parallel with the edge of the vomer, slopes upward and backward, the actual vertical height of the pharynx is less than the former figure, averaging about 20 mm. in the adult. The anteroposterior depth is least next to the sloping roof, and greatest at the level of the inferior choanal rim. The obliquity of the choanal plane is not recognizable in the mirror image.

The normal anterior wall of the pharynx shows the sharply defined edge of the nasal septum in the median line. Prominences on either side of the septum are pathologic. The rear ends of the inferior and middle

turbinals are well seen in the normal image. They appear as pale, scarcely pink, obliquely pendant lobules, the lower even paler than the middle, and are covered with a smooth mucous lining. Normally there is a distinct space between the turbinals and the septum. Morbidly they may be enlarged to a variable extent, even projecting into the nasopharynx, and of a bluish, livid hue. Each choanal opening is oval, the upper rim being slightly more curved than the lower. Asymmetry of the two choanæ is rare and not normal.

Prominent landmarks on the lateral sides of the upper pharynx are the projecting Eustachian orifices posterior to the inferior turbinals and about on their level. The yellowish-white, funnel-shaped orifice is surrounded by projecting lips, an anterior and a posterior one, which, by diverging downward, give the opening the shape of a triangle with curved outlines. The prominence of the Eustachian tube is subject to variation, and in proportion to its projection varies the depth of the recess above and behind the Eustachian lips—the Rosenmüller fossa.

When a rhinoscopic view cannot be obtained, examination with the finger can inform the surgeon regarding the size of the pharyngeal tonsil, and any existing hypertrophy of the inferior turbinated or other growths. A practical plan to prevent children from biting during the digital examination is to press in the cheek between the molar teeth with the other hand.

**25. Methods of Treatment in Nasal and Pharyngeal Affections.—Applications in Nose and Pharynx.—** The **nasal douche** is used for both diagnostic and therapeutic purposes. When we wish to know if there is any secretion in the nose, in case it cannot be seen, it will be found in the basin receiving the water with which the nose has been flushed. The douche serves likewise to remove viscid secretion or crusts in order to expose the surface to view. For curative purposes the douche is invaluable in all cases in which the discharge cannot be removed by other means—viz., when it is dried in exten-

sive crusts or when it is viscid. The principle of the douche is simply to wash the nasal surfaces with a current of indifferent fluid. Pure water is more irritating than the so-called physiologic salt solution—*i. e.*, common salt in the strength of 0.5 to 0.7 per cent., or the same amount of sodium bicarbonate. The douche should never, however, be given unnecessarily to a patient, since its careless use may involve a grave danger. If the water enters the rear of the nose with pressure, or if the patient swallows during the time and thereby causes gaping of the Eustachian tubes, the water may enter the middle ear. This accident causes, as a rule, suppurative inflammation of the middle ear, sometimes of great severity. It is probably not the presence of the water as such in the middle ear that does the mischief, but the water in entering carries with it pathogenic germs that abound in every diseased nose.

In order to guard against this danger I have learned to use a pointed nozzle that does not occlude the nostril, in preference to the olive-shaped bulb usually fitted to the douche. I likewise find it more convenient to use as syringe a large rubber bulb held in the hand rather than the irrigator ordinarily sold as a nasal douche. The water should be of the temperature of the body, and the patient must not swallow, cough, or spit while the water flows. When the patient leans forward with the mouth open, the palate is raised by reflex action while the water flows through the nose, so that the fluid does not get into the lower pharynx at all or only to a limited extent, but returns through the other side of the nose. If one side of the nose is narrowed, the fluid should always be made to enter through the narrow side, in order not to be under pressure in the upper pharynx.

With these precautions I have not had a single accident in many thousand applications made by myself. Before I became familiar with all these details I have had patients state a number of times that they felt the water entering one or both ears. In every one of these

instances I inflated the middle ear immediately by the Politzer method or with the catheter, and in no case were there any further consequences. The use of the douche in the hands of the patient is necessarily more likely to lead to this accident than when done under the eyes of the surgeon. Hence the douche should never be ordered except when actually required. The various cup- or spoon-shaped vessels sold as nasal douches involve all the dangers of nasal irrigation without its real utility, since their contents do not reach the upper portions of the nasal chamber.

When we wish to cleanse the nasopharynx more than the nose, the **postnasal douche,** a long tube with curved beak connected with the douche-syringe, is inserted into the nasopharynx through the mouth, and the fluid is allowed to run off through the nose. The same precautions are required as with the ordinary form of nasal douche.

The object of the douche—viz., the removing of viscid adhering secretion or crusts—cannot be attained by snuffing up fluids or by pouring them into the nose with a spoon or spoon-shaped vessel. A forcible jet is required for the purpose. Hence atomizers, too, are but an imperfect substitute for the douche. But as their use involves no danger to the ear, we must often be contented with some form of spray-producing apparatus in the hands of the patient, especially in the case of unruly children. A copious spray, followed by repeated blowing of the nose, will remove fluid secretion fairly well, but not adherent crusts. Considerable air-pressure is necessary to produce a good spray. A single rubber bulb is preferable to a double bulb. For office use a tank for compressed air is a great convenience, though not an absolute necessity. About 20 pounds' pressure answers all demands. When the spray is used for cleansing purposes, a 1 per cent. solution of sodium bicarbonate is all that is required.

**Antiseptics** of a sufficient strength for actual disinfection

are not tolerated by the mucous membrane. Besides, it has been shown by numerous experiments that mucous membranes cannot be sterilized in the same manner as the skin. The only substances suitable for sprays to which a distinct influence and perhaps a slight antiseptic effect can be ascribed in the treatment of nasal diseases are the essential oils dissolved in water. These solutions are not irritating; if anything, they are agreeable and clinically superior in their therapeutic effect to indifferent fluids. After many trials the author has found the following preparation the most agreeable: Oil of cloves, 2 per cent.; oil of wintergreen, 0.5 per cent.; menthol, 0.5 per cent., are triturated with magnesia, and the necessary quantity of water, with the addition of 1 per cent. of sodium bicarbonate, is added and the mixture filtered. Only a part, however, of the essential oils really enters into solution. A favorite solution with many for nasal use is Seiler's antiseptic solution, which contains:

| | |
|---|---|
| Sodium bicarbonate | 240 grains |
| Borax | 240 " |
| Sodium benzoate | 10 " |
| Sodium salicylate | 10 " |
| Eucalyptol | 5 minims |
| Thymol | 5 grains |
| Menthol | 2½ grains |
| Oil of wintergreen | 3 drops |
| Glycerin | 4 ounces |
| Alcohol | 1 ounce |
| Water to make 8 pints. | |

The ingredients are also put up in tablets, of which one is intended for a two-ounce solution. For nasal use Dobell's solution, quoted extensively in text-books, consists of:

| | |
|---|---|
| Borax | 1 dram |
| Glycerinated carbolic acid (20 per cent.) | 2 drams |
| Sodium bicarbonate | 1 dram |
| Tepid water | ½ pint. |

Neither of these solutions can be said to possess any

therapeutic influence beyond the mechanical effect they exert as spray or wash.

An antiseptic fluid of great penetrating power and intense germicidal action (within a few seconds) is Löffler's solution, much used in diphtheritic and other infectious forms of pharyngitis. Its formula is—

| | |
|---|---|
| Menthol | 10 |
| Toluene | 36 |
| Creolin | 2 |
| Tincture of iron chlorid | 4 |
| Alcohol | up to 100. |

To be applied undiluted and kept in contact for at least ten seconds (see ¶ 203).

**Oily solutions** made with liquid petroleum or the hydrocarbons, known as albolene, etc., can be diffused well in the form of fine sprays by the class of atomizers known as vaporizers. The author, by unprofitable experience, has become fully satisfied, however, that there is no permanent benefit of any kind to be obtained from oily solutions. Even the striking influence of menthol solutions in vaselin is but transient, and gives no satisfactory result in the end.

**Fluids** are best applied to small areas of the nasal surface on pledgets of cotton wound around wooden tooth-

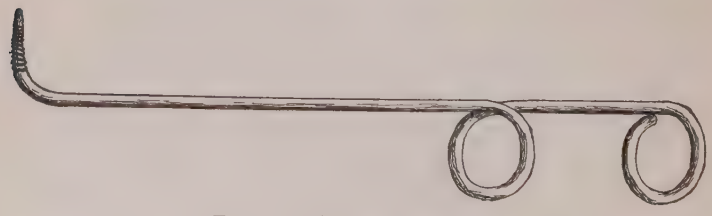


Fig. 20.—Pharyngeal applicator.

picks. Applications to the pharynx require the use of long wire applicators, the end of which is bent at a right angle (Fig. 20). Cotton is wrapped around the screw-thread at the end. Brushes and sponges should never be successively used on more than one patient.

**Powders** are blown into the nose and pharynx by means of insufflators (Fig. 24). Such instruments, with a receiver for holding a store of the powder, have been devised by the author, De Vilbiss, and others. Curved tube attachments permit the blast to be directed upward in the pharynx. An additional tubular nozzle facilitates asepsis of the end of the instrument.

The lower pharynx is commonly supposed to be reached by **gargling**. This is not entirely true. During gargling contact between the root of the tongue and the soft pal-

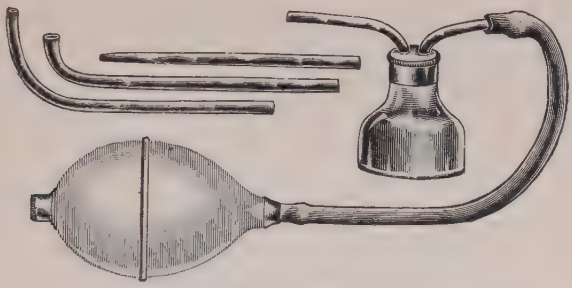


FIG. 21.—Author's powder-blower.

ate separates the mouth from the pharynx proper, and drops of the solution pass this barrier only by accident. This has been shown by using staining solutions. Hence since the gargling fluid reaches the rear pharyngeal wall but very imperfectly, this mode of application is less efficient than that of brushing or sprays.

**26. Action of Drugs upon the Respiratory Mucous Membrane.—Cocain** constricts the blood-vessels of the surface to which it is applied, and thus shows the difference between their distended and contracted condition. Its effect, hence, permits a better view of the interior of the nose. It gives a subjective feeling of clearing of the nose, which is more marked the greater the previous obstruction caused by vascular distention. A 2 per cent. solution does this fairly well unless the mucous membrane is inflamed, when a strength of about 1 : 20 is required. A spray of this strength is harmless if used

sparingly. For anesthesia a solution of at least 5 per cent. strength is necessary. If deep action is desired, 20 per cent. and from five to ten minutes' contact are required. The anesthesia lasts from ten to twenty minutes. The author has made use of this strength of cocain solution on pledgets of cotton tightly wrapped around toothpicks in thousands of instances, and has never seen any alarming effects produced. It is not an uncommon occurrence, however, for the patient to complain of subjective faintness or "nervousness," due partly to the cocain and partly to the dread of operations, and it is well to be prepared to have the patients lie down for a few minutes. When, formerly, the author used cocain on *loose* pledgets of cotton, he saw these accidents more frequently and twice was embarrassed by acute maniacal attacks lasting a few hours. In children I have occasionally observed embarrassing talkativeness after the pharyngeal use of cocain. Since more serious accidents have been recorded by others, care should be used in the employment of cocain to avoid any dripping of the solution into the lower part of the throat.

A deep localized anesthesia can be obtained by the submucous injection of weak solutions of cocain (0.5 to 1 per cent.) or eucain (0.2 per cent. in indifferent salt solution (0.6 per cent.) according to the Schleich method of infiltration. This is especially applicable in operations on the septum. An ordinary hypodermic syringe with long needle is required.

An excellent substitute for cocain for the purpose of local anesthesia is **nirvanin**. It has been found harmless and not productive of poisonous effects, but it acts only when injected into the tissues, and not on the free surface. It may be used in from 3 to 5 per cent. solution in water.

In order to anesthetize the pharynx the applicator, moistened, but not dripping, with cocain solution (20 per cent.), must be held in place for a few minutes. The pharyngeal anesthesia is neither complete nor deep.

Cocain anesthesia in the nose or pharynx is very much intensified by the anemia caused by a prior employment of suprarenal extract. Under no circumstances should cocain be given into the hands of patients, for fear of inducing the pernicious cocain habit. The relief this drug gives in turgescence of the nasal lining is a great temptation to its continued use. In cases of known idiosyncrasy against cocain **eucain** $\beta$ may be used in its stead in 5 per cent. solution for purposes of anesthesia, but otherwise it has no advantage over cocain. Eucain does not constrict the blood-vessels.

**Orthoform** has no influence upon intact mucous surfaces, but its remarkable anesthetic effect upon exposed tissues can be utilized advantageously by blowing the powder upon painful wounds—for instance, after tonsillotomy. Intranasal wounds do not ordinarily require it.

A solution of the active principle of the **suprarenal gland** produces an intense anemia upon local application, which continues for one or two hours. On inflamed surfaces its effect is more difficult to obtain and more transient. Its use renders nasal operation almost bloodless. Its previous application intensifies cocain anesthesia. A 5 to 10 per cent. solution suffices. The solution filters very slowly, and hence may be prepared by allowing the dried powder from which it is made to settle by deposition. It putrefies speedily unless preserved sterile. It is not altered by boiling, but the sterility is lost on opening the flask. The addition of 1 per cent. chloroform (more than enough to saturate water) preserves it permanently. The chloroform is only very slightly irritant, and may, besides, be driven off by heating. Chloroform is also a useful agent for the preservation of sterility of other solutions, kept in bottles repeatedly opened—for instance, cocain. As a spray for the temporary reduction of intranasal turgescence a solution of cocain (2 per cent.) and suprarenal extract (2 per cent.) is very appropriate in the hands of the surgeon. In rare instances, however, suprarenal solution causes disagreeable sneezing fits—coryza

vasomotoria. Suprarenal solution loses its activity gradually. In order to be reliable it should have been prepared within less than one week.

**Menthol,** too, produces constriction of the venous plexus in the mucous membrane, but less than cocain. The subjective feeling of clearness due to the reduced turgescence is intensified by the cooling sensation caused by menthol, but it does not anesthetize the surface. A fine spray of menthol dissolved in six parts of fluid vaselin or albolene gives a pleasant relief whenever the nasal passage feels "stuffy," but the effect is transient in proportion to the inflammatory condition causing the vascularity. Coarse sprays or menthol solution applied directly are irritating.

**27. Surgical Procedures in the Nose and Pharynx.**—In order to avoid repetition it may be convenient to describe certain surgical measures which are employed in various morbid conditions.

**Cauterization.**—Superficial cauterizations can be made with a bead of silver nitrate melted on a probe without unpleasant reaction. A deeper caustic effect is obtained by chromic acid handled in the same way. The excess should be washed away with sodium bicarbonate solution. Chromic acid burns are often slow in healing. This disadvantage does not apply to cauterization with trichloracetic acid, which causes less inflammatory reaction than the former, while very voluminous eschars indicate its penetrating power. Its hygroscopic nature renders it awkward to manage. Only fresh dry crystals can be melted on a probe, and this with difficulty. The crystals can be held in cup-shaped applicators, or when melted may be absorbed by cotton wound around a probe. The application of the acid should be followed at once by an alkaline wash. The slough produced by chemical or actual cauterization becomes detached within from four to seven days, according to its depth. The wound then heals in from six to fifteen days and requires no treatment except occasional removal of crusts.

The deepest and most localized caustic effect is obtained by means of galvanocaustic burners shaped according to the locality and object they are intended for (Figs. 22 and 23). The handle of the cautery must have a push-

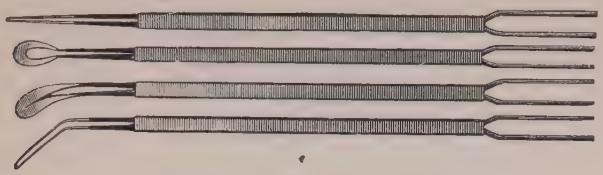


FIG. 22.—Galvanocaustic burners.

button in order to regulate the duration of the current. By far the most convenient source of electricity is a converter attached to a low tension, alternating street current, when accessible, as this requires no care. When only a

FIG. 23.—Handle for galvanocaustic electrodes.

"constant" street current is available, the problem of getting a current of low voltage (from 6 to 10 volts) and of sufficient intensity (20 to 25 ampères) is more complicated. The large rheostats supplied by makers cannot be recommended. They are expensive, absorb very much current, and still give too high a voltage, which, in case of a "leak," may prove at least very unpleasant, if not dangerous. It is preferable to interrupt the current by a motor and then to reduce the voltage by a converter, as sold by the Edison and other companies. A "motor converter" may be used, which, by double winding of the armature, gives a suitable current of low voltage. An excellent one made by the Victor Electric Co., of Chicago, has been used by the author for several years with satisfaction (Fig. 24). The motor itself, when connected with a "dental arm," is a very convenient source of

power for operations with drill or trephine. A storage battery of two, or, better still, three, cells of good make and well charged in the first place is the next best source of electricity. It must be kept charged by connection with a lighting current at intervals of some weeks. If allowed to remain inactive too long, "it runs down" by means of internal chemical changes and then requires a charging current of several ampères in order to be restored. Constant batteries generally require fre-

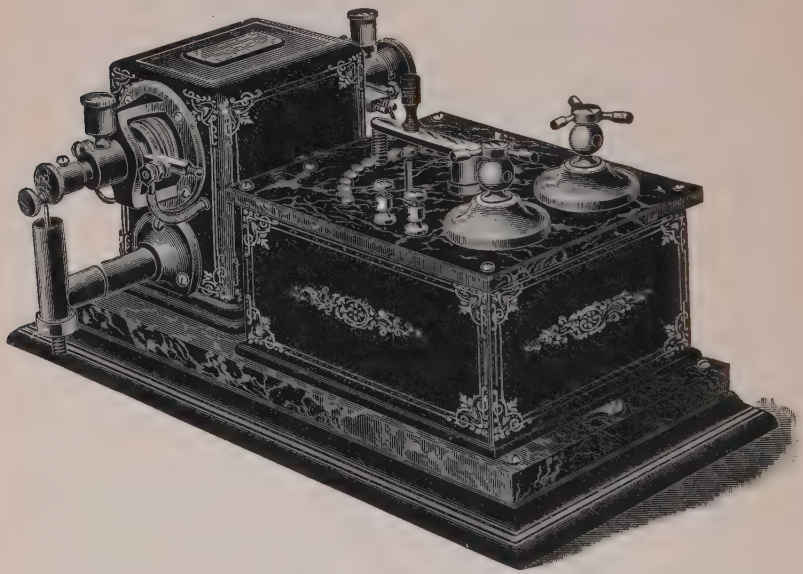


FIG. 24.—Victor motor transformer for cautery with attachment for dental cable for operating drills, etc., also an attachment for pump for ear massage.

quent attention and refilling in order to keep in good condition. The directions are supplied by the manufacturer. Perhaps the most desirable of all available cells is the Edison Lacland type, largest pattern, of which three in series, or six in two series of three, are necessary. Since both constant batteries and storage-cells lose slightly in the course of time, it is best to have an excess of power in the first place. A small rheostat or the resistance of a variable length of thick German-silver wire

regulates the strength of current. With a voltage of at least six volts the cords used commercially for electric drop-lights (largest size) are available in preference to the stiffer cords generally sold by the surgical supply houses.

The object of cauterization is to remove redundant tissue. If this can be done with scissors or snare, a clean and rapidly healing wound is left, which is much preferable to the slow healing and discomfort of a burnt wound. But cutting instruments are not always applicable, especially in the case of flat tumefactions or enlargement of the submucous venous plexus. The heated burner acts beyond the area of the eschar which it produces, causing thrombosis in the adjacent vessels, with considerable ultimate obliteration. It is an advantage to destroy as little as possible of the mucous surface, which can be done by making multiple deep punctures instead of extensive surface burns. The larger the surface that has been destroyed, the slower the healing and the greater the probability of secondary infection during healing. Besides, the resulting scar is liable to be covered with crusts for long periods of time. Attempts have been made at submucous cauterization with needle-shaped burners, but the results do not differ materially from multiple punctures.

FIG. 25.—Jarvis' snare.

**28.** An instrument much used for nasal work is the *snare* (Figs. 25, 26, 27). The most convenient form is that in which the wire is threaded through an eye in a stilet, like Wright's and Krause's. Otherwise much time is wasted in pulling the wire

through the cannula. Steel piano wire is used, but should not be bought on spools, as such winding curls

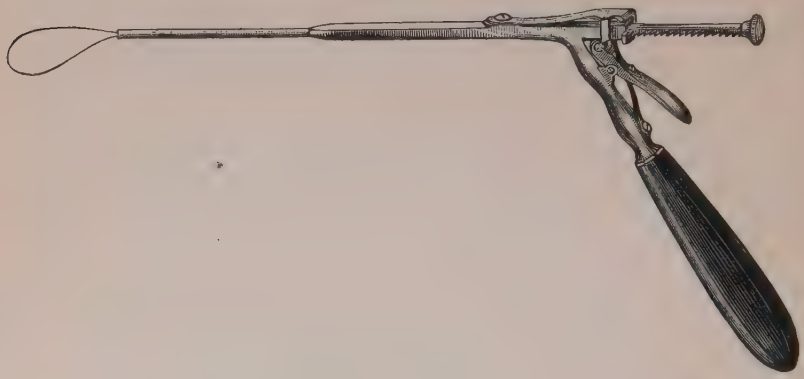


FIG. 26.—Wright's snare.

it too much. The snare loop is slipped around the utmost base of the growth to be removed. When the

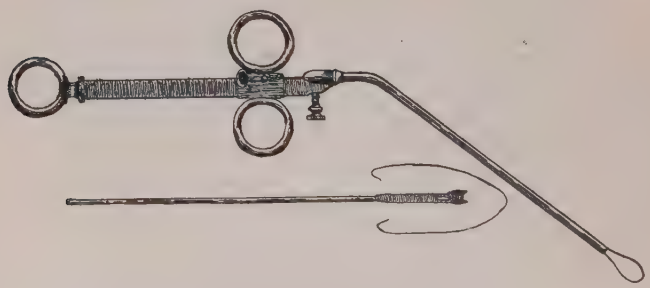


FIG. 27.—Krause's nasal snare (with stilet).

growth is flat and does not project, it can be transfixed with a needle (Fig. 28), over which the loop of wire is

FIG. 28.—Jarvis' transfixion needle.

slipped. Where hemorrhage is feared on account of vascularity, the cutting should be done very slowly

(preferably with a Jarvis snare, the nut of which is turned gradually).

The hot snare (Fig. 29), an attachment to the galvanocautery handle, has little advantage over the cold snare. The difference in the amount of bleeding is, as a rule, only slight, whereas the inconvenience of the hot snare to the surgeon is considerable. The same steel wire may be used as in the cold snare, but must be replaced each time. Platinum wire is not much better and very expensive.

**29. Hemorrhage from the nose** or that following operations in the pharynx will generally cease spontaneously if not of arterial origin. The patient should keep quiet

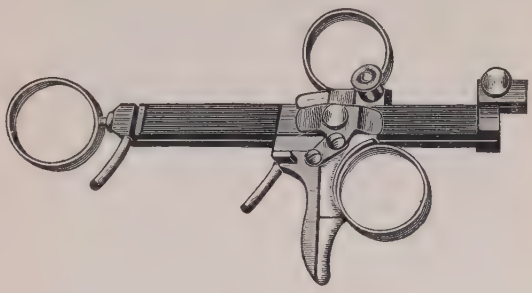


FIG. 29.—Galvanocaustic snare-handle (Kuttner's).

and reduce the blood pressure in the head by standing upright or at least sitting. Tannin and other astringents blown into the nose or pharynx do not stop bleeding. A more definite effect on hemorrhage can be obtained by the use of coarse *glutol* powder, which probably acts mechanically. If the nasal bleeding is arterial—if it spurts and is bright red—or even if venous, and does not cease soon or is very copious, the nose must be plugged. A strip of iodoform gauze 1 to 2 cm. wide and about ½ m. in length is packed in with the probe. Cotton will answer equally well for the time, but in the case of wounds does not help to keep them aseptic. It is handy to wind the cotton in required thickness upon tooth-picks, using a sterile cloth over the fingers in order

not to infect the cotton. If the hemorrhage is from the rear end of the turbinal or from the pharyngeal vault, the upper pharynx must be packed. A plug of iodoform gauze or iodoform cotton with a string attached can be pushed up behind the palate through the pharynx by means of curved forceps, if necessary with the aid of a palate retractor. This is difficult on account of the patient's gagging. A neater way is by means of a Belloc's sound (Fig. 30). The slightly curved tube is passed through one nostril. A springy stilet, when pushed through this tube, curves down behind the soft palate, and the cord attached to a gauze plug can then be threaded through the eye of the stilet in the mouth. Upon withdrawal of the Belloc sound this cord can now be pulled at its emergence from the nostril, and the plug

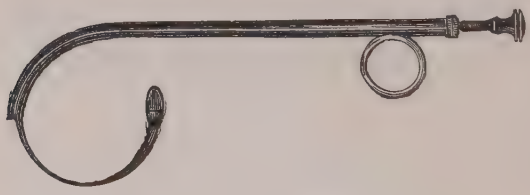


FIG. 30.—Belloc's sound for plugging the postnasal space.

thus be lifted into place. A second string attached to the plug hangs out of the mouth and is tied over the upper lip to its mate in the nose.

Packing does not stop the visible hemorrhage instantly: it usually requires a few minutes' waiting. If the hemorrhage persists to an alarming extent after packing, cotton plugs moistened with iron persulphate will control it. On account of the irritation that they produce, however, they should never be used except in case of positive danger. Less disagreeable than the iron solution and nearly as effective is the combination of antipyrin and tannin, which forms a sticky paste. The cotton plug or pledget is brushed with antipyrin solution (10 per cent.), then dusted freely with tannin powder. In persons known to be bleeders it is best to avoid nasal operations,

if possible. In such subjects even the galvanocaustic burner may lead to embarrassing secondary hemorrhage. Several personal experiences, however, with bleeders terminated well ultimately.

**30.** At the present time every surgeon recognizes that it is his duty to have every instrument sterilized before it is brought into contact with a wound or an absorbing sur-

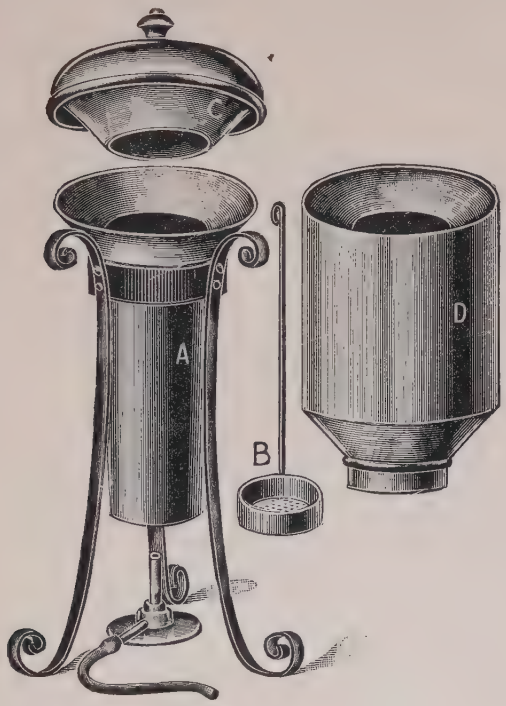



FIG. 31.—Author's sterilizer with removable bottom (B) and cover (C). D is a steam chamber for steam disinfection.

face. The only method that gives absolute assurance of complete disinfection is three minutes' boiling in 1 per cent. sodium carbonate solution. In the absence of spores, even one minute suffices to kill germs. On account of the solvent action of hot soda solution upon dirt this renders unnecessary the painstaking scrubbing which must precede immersion in cold antiseptic solutions (5 per

cent. carbolic acid or 0.1 per cent. corrosive sublimate). It is advisable to have a sterilizing kettle (Fig. 31) in permanent use next to the instrument table, and to get into the habit of throwing all instruments into it after use. For instruments used merely for examination and not coming into contact with wounds,—for instance, the rhinoscopic mirror and the nasal speculum,—scrubbing with a brush under running water suffices, whereas the mere dipping into a disinfecting solution is useless, because inefficient. When there is any suspicion, however, of contagious disease, syphilis, tuberculosis, diphtheria, or even acute angina, it is our duty to boil the instruments after use, even if the rhinoscopic mirror does deteriorate gradually. The nozzles of rubber throat-atomizers withstand boiling without damage. Cotton swabs wound on tooth-picks for mopping and for applications can be kept aseptic by handling the cotton with a sterile cloth instead of with the naked fingers.

It has been claimed by St. Clair Thompson and Hewlett that the normal nasal lining is generally free from bacteria, and that they are largely deposited in the vestibule or expelled from the mucous surface by the movements of the epithelial cilia. As all other mucous membranes are likely to have germs upon their surfaces, this statement ought not to be accepted fully until it is extensively corroborated. The impossibility of practically sterilizing other even more accessible mucous membranes, like those of the conjunctiva or vagina, excludes all hope of successfully sterilizing the surfaces of nose or pharynx by present methods. Since the nasal mucous membrane cannot be made sterile, we cannot guarantee an aseptic course after operations. Attempts to keep the surfaces protected against germs by means of painting with methyl-violet and other antiseptic substances have not proved successful and do not seem rational to the bacteriologist. The only real protection is afforded by iodoform gauze packed closely against a wound, since iodoform in powder form is soon swept away by secretion.

Clinical experience has led me to trust, to some extent, to glutol in coarse powder blown upon the thoroughly clean and dry wound. This substance, by reason of its absorbing power, helps to stop bleeding and forms a well-adhering crust under which wounds in the nose and throat have healed in a very clean and rapid manner. Fortunately, however, wounds in the nose and throat do not often follow an untoward course. Superficial infection is almost inevitable except under iodoform gauze or under a glutol scab, but suppuration of wounds is not common in the nose, although more so in the pharynx. Traumatic erysipelas is very rare. Pyogenic infection of nasal wounds sometimes leads to acute tonsillitis—on the same side and perhaps later on the other side—or to suppurative inflammation of the middle ear or of the maxillary sinus. Streptococcus infection may manifest itself by the prolonged formation of false membranes with delayed healing, but usually without serious danger.

**History and Literature.**—The former scanty knowledge concerning surgical diseases of the nose and pharynx (polypi, malignant tumors, empyema of frontal and maxillary sinus, and tonsillar enlargement) can be found in the text-books on surgery of the various times. From a medical point of view, these parts received no attention worth mentioning prior to the introduction of the laryngoscope by Türck and Czermak (1858), except in the case of acute infections of the pharynx. In 1859 Czermak applied the inverted laryngoscopic mirror to the postnasal space. Anterior nasal inspection through a speculum was employed by Markusovszki, of Pesth, in 1859, but popularized by Thudichum (Duplay, and especially B. Fränkel) only after 1868. Thudichum also introduced into therapeutics the nasal douche (1864) previously used for physiologic purposes by Weber. The danger of the douche to the ear was later shown by Roosa. While the knowledge of the various affections of the nose was gradually augmented by laryngologists of all countries, the most important discovery regarding postnasal pathology was the description of the enlarged pharyngeal tonsil (adenoid vegetations) by W. Meyer, whose first report in Danish literature in 1868 was supplemented by his more accessible German publication in 1873. Medical interest in the nose as a source of wide-spread nervous

"reflexes" (asthma, headache, etc.) was aroused by Hack's announcements in 1881, continued for several years. The important rôle played by the accessory cavities in suppuration hitherto considered of intranasal origin was emphasized by Ziem in 1881, and has received extensive attention within the last twelve years.

Rhinologic study should begin with the fundamental treatise by Zuckerkandl on the anatomy of the nose (magnificently illustrated), *Normale und pathologische Anatomie der Nasenhöhle*, Bd. i., 1882, and 2. Ed., 1893, Bd. ii., 1892. Nasal pathology is illustrated by Seifert and Kahn's *Atlas der Histopathologie der Nase, Mundrachenhöhle, und des Kehlkopf's*, 1895. Among general treatises on nose and pharynx B. Fränkel's volume in Ziemssen's *Handbuch d. spec. Pathologie* (1876) was the earliest in date, while among the most comprehensive recent text-books may be mentioned Burnett's *System of Diseases of the Ear, Nose, and Throat*, 1893, and especially the *Handbuch der Laryngologie und Rhinologie*, begun in 1896 under the editorship of P. Heyman. Among the landmarks on this subject may be mentioned the *Diseases of the Throat and Nasal Passage* by J. Solis Cohen, 2 Ed., 1879, and *The Diseases of Nose and Throat*, by Morell Mackenzie, vol. i., 1880, and vol. ii., 1884. Much historic information can be found in this work and in J. N. Mackenzie's articles on "Nasal Affections" in Wood's *Reference Handbook of the Medical Sciences*, vol. viii.

## CHAPTER IV.

### DISEASES OF THE VESTIBULE OF THE NOSE. CORYZA.

#### DISEASES OF THE VESTIBULE.

**31.** The entrance into the nose is not often the primary seat of disease, but suffers frequently in the course of various intranasal affections, especially purulent rhinitis.

**Eczema** occurs sometimes in the acute, more often in the chronic, form. The characteristic vesicles are soon transformed into moist scabs covering an excoriated, bleeding surface. The patch extends usually downward over the upper lip, but is sometimes limited to the floor and sides of the vestibule. Eczema is most commonly seen in scrofulous children. Sometimes it is also a persistent annoyance in adults with morbid nasal secretion. When of long duration, it is likely to cause thickening of the upper lip, typically seen in scrofulous children. The eczematous abrasion may permit the entrance of the tubercle bacillus into the lymphatic system, as indicated by permanent enlargement of the anterior cervical lymph-glands. It may likewise prove the starting-point of facial erysipelas. The eczematous crusts should be removed, and the surface protected by a zinc oxid lanolin salve (50 per cent.). Rebellious cases are cured in the quickest manner by cauterization with silver nitrate, repeated if necessary. Oil of cade salve (1 : 4) and balsam of Peru act more slowly, but are especially useful in preventing relapses.

An annoying and easily overlooked lesion is a **shallow fissure** at the junction of the septum and the lateral wall of the external nose. It is more or less painful, always tedious in its course, and likely to recur if partially healed. Sometimes it maintains an embarrassing red-

ness of the tip of the nose. Occasionally it is the starting-point of spells of sneezing. Its presence favors acute "colds." A fissure causes pain when the nasal speculum is inserted. It can be seen on searching for it. It yields most readily to repeated applications of silver nitrate solution (30 per cent.) on thin cotton applicators.

**Furuncles of the hair-follicles** in the vestibule give rise to decided pain and swelling and sometimes to external redness. A furuncle can be recognized as a small papular swelling on the inner surface of the side of the nose. It should be incised if it has not broken spontaneously. Relapses are common. The best prevention in my experience is to brush the inside of the side of the vestibule with a weak (4 per cent.) solution of silver nitrate once in a few days for a number of weeks.

### CORYZA; ACUTE NASAL CATARRH; ACUTE PURULENT RHINITIS (SNUFFLES, IN NURSERY PARLANCE).

**32.** Acute nasal catarrh is the most common of all diseases. Very few persons pass many years without an attack. The well-formed normal nasal passages of vigorous individuals may not be invaded for a number of successive years, while poor health and especially deformed nasal passages and chronic intranasal lesions predispose to repeated attacks within one season. Hereditary syphilis is a noteworthy predisposing condition in infants. No age is exempt, but coryza occurs less frequently after middle age is passed. Least common during equable weather in summer, or during a uniform dry, cold spell in winter, it is most prevalent after changeable weather in fall and spring. Its geographic distribution, too, corresponds with the peculiarities of the climate.

The attack begins with sneezing, followed by a feeling of fulness in the nose and head, which culminates after some hours in nearly total occlusion of at least one side of the nose, sometimes of both. At the same time there occurs a watery, acrid discharge, becoming purulent in the course of about twenty-four to thirty-six hours,

after which time the secretion is a thick, purulent mucus of yellowish-greenish tinge, sometimes slightly bloody. The full feeling increases during the first day, and is sometimes accompanied by considerable headache. On account of the swelling around the Eustachian orifice the ears may feel "stuffy." In children, less commonly in adults, a febrile rise of temperature of from 1° to 3° F. may be noticed. Quite often a general feeling of malaise and lassitude is felt. The tongue becomes coated, the appetite often is impaired, all the more so as the sense of smell may be absent and hence taste interfered with. The smoker refuses his cigar.

In the typical attack, not modified by preexisting chronic nasal disease, this condition lasts two or three days, and then begins to decline. The nose becomes clearer,—at least one side at a time,—although the discharge is more likely to increase during the first three days. The secretion is likely to cause excoriation of the skin at the entrance of the nose, which in its turn may prolong the annoyance. The discharge changes gradually into clearer mucus with purulent flakes. In uncomplicated instances, not prolonged by exposure, all symptoms disappear completely in from six to ten days.

Inspection shows the mucous membrane to be reddened and thickened. The occlusion of the passage is partly due to turgescence of the submucous venous plexus. This may be overcome transiently by the pressure of a probe or by the action of cocain or suprarenal extract. The mucous membrane, however, is, besides, swollen from infiltration with leukocytes and serum. During the receding period the vascularity diminishes and the membrane is sometimes seen to be edematous—soggy. Acute rhinitis is a diffuse process involving the entire lining of the nose uniformly. Examination with the postnasal mirror, when feasible, shows that the pharyngeal tonsil is, as a rule, involved, being reddened and swollen, though to a variable extent in different patients. In some instances the inflammatory redness and swelling

extend visibly along the pharyngeal mucous membrane down below the level of the soft palate.

Histologically, coryza is a diffuse leukocytic infiltration, with congestion of all vessels, especially the venous plexus, and with partial loss of the ciliated epithelium.

Deviations from the clinical course, as described, may occur in either direction. In patients with either chronic suppurative or hypertrophic rhinitis acute exacerbations occur with symptoms of a milder character than in the typical attack. The climax, which is not so severe as in a hitherto normal nose, is reached within the first day, and within from three to five days the symptoms subside to the grade they presented prior to the fresh "cold." Some patients give the history of frequent "colds" lasting only a few hours. These are, however, not inflammatory attacks at all, but merely spells of turgescence of the cavernous tissue, with sneezing, occlusion of the nose, and a copious watery discharge entirely free from pus. On the other hand, nasal stenosis may cause a prolongation of the climax for several days and may lead to an indefinite persistence of the symptoms during the declining stage. Delay in the disappearance of an acute coryza may also be caused by exposure to inclement weather and insufficient protection against cold.

In the light of our present knowledge we cannot but attribute acute purulent rhinitis to the action of some widely distributed parasite. In spite of many attempts the virus has not yet been identified. At times coryza attacks a number of persons in a household in succession, so that a suspicion of contagiousness seems warranted. Direct inoculations, however, with the discharge have failed to transfer the disease. The presence of various forms of pyogenic cocci during the declining stage, and especially in protracted nasal suppuration, makes it probable that secondary infection often plays a rôle. Popularly, acute catarrh is always ascribed to "taking cold." As stated in Chapter II., there is no reason to doubt that chilling is an important factor in causing chronic cir-

cumscribed inflammatory processes to become acute and diffused. The fact, however, that the same chilling of the body does not always or even often lead to the same result signifies that it must coincide with other influences which we do not know. In the acute catarrh of hitherto normal noses the chance of satisfactory inquiry is so rarely afforded to the physician that a definite opinion concerning the importance of "taking cold" cannot be given.

An acute purulent rhinitis is often a part of the clinical picture of influenza, although this disease may also occur without it. In measles there is always an inflammatory condition of the nose, with watery discharge as the first manifestation. In some instances the nasal symptoms subside without suppuration as soon as the cutaneous eruption has appeared; in others they develop into an ordinary coryza which is apt to be prolonged in a subacute form.

Coryza involves no danger to life in the adult. In infancy, when the nasal passages are relatively narrow, it may be accompanied by great swelling (and subsequent hypertrophy of the pharyngeal tonsil), and the interference with nasal respiration, causing dyspnea and restlessness, gives the appearance of serious danger. But, after all, fatal issues must be very uncommon, if they ever do occur in uncomplicated cases. A serious danger in infants is the possible complication with bronchitis and bronchopneumonia. Although complete spontaneous recovery is by far the most common result, acute catarrh may change into a persistent chronic inflammation if there is nasal stenosis, if it be prolonged by exposure, or if often recurrent. The acute inflammation may also extend into the accessory cavities. This is probably the case more often than is now taught, especially so far as the ethmoid cells and sphenoid sinus are concerned, and the severe headache sometimes present during a "cold" is probably due to this extension. However, most of the acute inflammations of the sinuses heal spontaneously.

Quite often acute rhinitis is attended with acute conjunctivitis, which can be improved by treatment (zinc sulphate solution, 0.5 per cent., or brushing with silver nitrate solution, 1 to 2 per cent.), but not entirely cured until the nose has become normal. The greatest danger of the disease is the extension into the ear, as secretory catarrh or acute purulent otitis—most likely when there is nasal stenosis. Coryza is rarely followed by tonsillitis, more often by tracheitis and bronchitis.

The **diagnosis** depends upon the acute nasal obstruction and purulent discharge. In doubtful cases inspection must not be omitted. A careless observer may make the diagnosis of simple coryza in cases of membranous or diphtheritic rhinitis, abscess of the septum, and in diphtheritic and non-diphtheritic inflammation of the pharyngeal tonsil. Genuine coryza must be differentiated also from acute but transient non-inflammatory vasomotor disturbances (spells of turgescence) in which there is no purulent discharge, and from the effects of iodism upon the nose. In iodin poisoning there is likewise no purulent, but merely a watery, secretion, although later on a secondary infection may change the character of the fluid. Moreover, the iodin effect ceases speedily on withdrawing the drug.

There is no **treatment** that can be considered curative or even permanently palliative. All statements concerning therapeutic results are merely copied from one book to another, or bear the stamp of hasty and unfounded generalization, and are found to be untrue when tested clinically. The popular belief in the abortive effect of quinin is a myth. Coryza cannot be aborted any more than any other infectious disease for which we possess no specific treatment. Cocain gives momentary relief, but no permanent benefit. The same is true of the douche. Suprarenal solution as a spray (2 to 5 per cent.) has a more lasting, even if transient, palliative effect, and is less objectionable than cocain. The quickest course is observed if the patient stays in the uniformly warm

room and avoids physical exertion. The headache of accompanying sinus involvement can be checked by antipyrin in the dose of 1 gram for an adult. The excoriations of the skin under the nose heal under any bland salve (oxid of zinc ointment or cold cream). The treatment of subacute exacerbations and chronic prolongation will be found in Chapter V.

## CHAPTER V.

### CHRONIC NASAL INFLAMMATIONS; "CHRONIC CATARRH"; CHRONIC PURULENT RHINITIS.

**33. Chronic Catarrh.**—The various forms of chronic nasal disease give rise to very similar symptoms—viz., discharge and obstruction. These symptoms were hence referred by the older writers, and are still by the public, to the existence of a "chronic catarrh." The so-called "catarrh," however, can be resolved into a number of separate affections and lesions, varying in character and significance. This clinical analysis is made difficult by the frequent coexistence of several lesions in the nose or throat. By selecting from a larger experience those cases in which only single lesions are present, certain types of nasal and nasopharyngeal disease can be established, which the diagnostician must recognize whether they occur in uncomplicated or in associated forms. The special term "chronic catarrh," if it is to be applied in its conventional sense to a chronic inflammation of a mucous membrane attended with mucous discharge, may be reserved for that form of nasal disease in which there is an excessive production of mucus—viz., retronasal catarrh. The ordinary chronic nasal and pharyngeal affections comprised under the generic term "catarrh" can be classified under the following heads:

| | | |
|---|---|---|
| Suppurative forms of inflammation. | With ordinary purulent discharge. | Chronic purulent rhinitis. |
| | | Suppuration of the accessory cavities. |
| | With modified purulent discharge. | Ozena (fetid atrophic rhinitis; simple atrophic rhinitis; anterior "dry" rhinitis (round ulcer of septum). |
| Non-suppurative inflammation. | With mucous discharge. | Retronasal catarrh. |
| | Without discharge. | Hypertrophic rhinitis. |
| | | Hypertrophic pharyngitis. |

Sequels of inflammation.
- Deformities of the septum.
- Enlargement of cavernous tissue.
- Diffuse hypertrophy of mucous membrane.
- Circumscribed hypertrophy of mucous membrane (polypi).
- Hypertrophies of pharyngeal adenoid tissue.

It will be most serviceable, however, to describe these affections in an order differing somewhat from the one best adapted for classification.

**34. Chronic Purulent Rhinitis.—Symptoms.**—Purulent rhinitis is characterized by the discharge of pus from the nose. As this symptom is common to various diseases, it must be determined in every case whether the pus comes from the nasal cavity itself, the roof of the pharynx, or from one or more of the accessory sinuses. According to the area involved in the disease the amount may vary from large masses of pus, viscid by reason of the mucin present, to trifling flakes that are easily overlooked. Some text-books speak of the occurrence of a catarrhal discharge. This term is likely to lead to error. In many forms of nasal disease the mucous membrane is abnormally irritable and secretes freely in response to irritation by dust or chilling of the body. When abundant, this fluid is watery, but when scant, it is very thick and viscid. This transient discharge is either entirely clear, indicating the absence of suppuration, or, when it occurs in connection with any purulent process, it is mixed with streaks of pus. Very scant purulent discharge may escape detection until the flakes are looked for in the water after douching the nose. Although the discharge is mostly blown out, it may pass also into the pharynx when formed in the posterior regions, or be guided thence by a stenosis anterior to the secreting region. The swallowing of copious purulent secretion may give rise to stomach disorders.

The other symptoms of purulent rhinitis, variable in different cases, are transient obstruction from the presence of pus or from vascular turgescence, and irritability, as shown by fits of sneezing and momentary watery flow.

Many patients are so little annoyed by the disease that the diagnosis is made only incidentally when ear or throat complications arise.

**Etiology.**—Chronic nasal suppuration is not a morbid entity, but may depend upon a variety of conditions which require detection in the individual case. Acute purulent rhinitis, especially when it is a manifestation of influenza, is likely to become chronic under certain circumstances. These are sometimes constitutional disturbances, chlorosis, malnutrition from other enfeebling diseases, and dyspepsia. Quite often the history is that of recurrent acute attacks, which finally become permanent, especially when exposure to "cold," insufficient protection, and longer spells of unfavorable weather have interfered with spontaneous recovery. Most commonly, however, local lesions will be found that account for the persistence of the disease. These are, in general, narrowness of the nasal passages, localized stenosis from deformities of the septum or spurs on its surface, or circumscribed hypertrophies of the mucous membrane in the form of papillomatous tumors upon the inferior turbinal, or polypi from the middle turbinal or external wall. Relatively often nasal suppuration is maintained by the enlarged pharyngeal tonsil in children or young adults. The presence of foreign bodies or of concretions may protract a nasal discharge indefinitely; in such a case it is most likely to be one-sided.

**Pathology.**—Examination shows that the purulent inflammation is rarely an extensive or a diffuse process; more often it is a localized condition, especially in the upper recesses. In the diffuse form the entire mucous membrane is reddened, but not much swollen. Even when a localized focus exists, a diffuse redness may be due to the coexistence of a diffuse non-suppurating, but hypertrophic inflammation, a not infrequent clinical combination. On the other hand, the entire lower intranasal area may appear normal. Sometimes the source of the discharge may be detected in a limited injected part of

the surface high up, the vulnerability of which is shown by bleeding when touched with the probe, or which is covered with granulations. Exposed bone is never found in simple purulent rhinitis. Its detection signifies syphilis or deep involvement of the ethmoid cells. In every case of nasal suppuration in which the discharge amounts to more than small flakes of pus, repeated efforts must be made to ascertain or exclude involvement of any of the accessory cavities, according to the methods to be described (¶ 40).

In a large proportion of cases purulent discharge from the nose comes from one or more of the accessory sinuses. Fetor of the discharge, especially if one-sided, suggests the possibility of a foreign body, particularly in children, or of a concretion (rhinolith). The diagnosis can easily be made with the probe.

In ordinary cases of uncomplicated purulent rhinitis the discharge is not fetid. Sometimes, however, the discharge is retained by swelling of the mucous membrane, due to circumscribed edema or granulating surfaces. It becomes inspissated, cheesy in appearance, and horribly offensive. This constitutes the rare form described as **rhinitis caseosa.** There is usually very much nasal obstruction in this form. By thorough removal of the pent-up secretion by irrigation it is changed into the ordinary purulent rhinitis, which then yields readily to treatment.

Uncomplicated chronic purulent rhinitis may disappear without treatment under improved climatic and hygienic environment. As a rule, however, it does not heal entirely during the warm season, but merely improves until unfavorable weather returns. Possible complications to which it may lead are chronic conjunctivitis, purulent inflammation of the tear-sac, ear disease (usually the secretory catarrh in a persistent form), chronic hypertrophic pharyngitis, and laryngitis or bronchitis.

**Treatment.**—The treatment is ordinarily successful if

properly individualized. It may succeed in a few days or may require many weeks. Faulty habits should be corrected, insufficient clothing, exposure to dust and weather, cold feet, constipation, stomach disturbances, or anemia should receive attention (see ¶ 14 to ¶ 17). Local treatment demands removal of the pus, as this fluid is too viscid to drain off without aid, especially when anatomic configuration favors its confinement. The most efficient measure is the douche, which is to be used daily—even several times a day (see ¶ 25). Irrigation through a small cannula (Fig. 32) may prove more satisfactory when hidden recesses are to be reached. A few days'

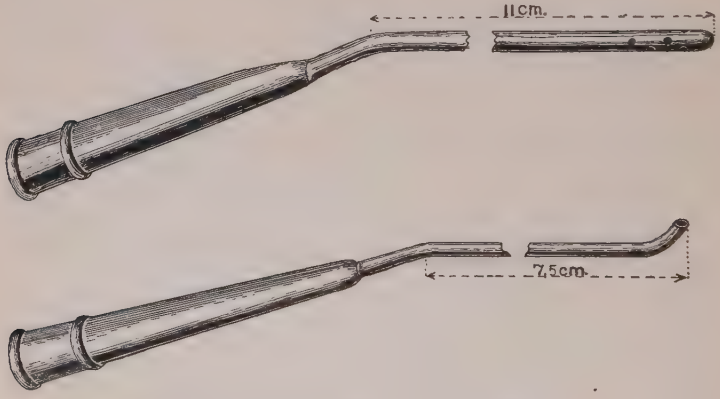



FIG. 32.—Grünwald's irrigating tubes.

steady use shows either the benefit of irrigation or its inefficiency in a given case. With abundant secretion and fairly wide passages the douche may be intrusted to the patient. In nasal stenosis this would be contra-indicated by the risk to the ear, and we must rely upon the use of a spray. Yet a spray from even a good atomizer is not an efficient substitute for the douche for the purpose of removing pus, especially if this be dammed up. The addition of medicaments to the spray solution exerts but little influence, as its effect is practically mechanical. A 1 per cent. solution of sodium bicarbonate or the pleasant solution of ethereal oils (¶ 25) may be used.

When a circumscribed area of pathologically changed mucous membrane can be detected, it should be treated by direct localized application. Localized surface inflammation yields to a few brushings with silver nitrate solution (5 to 10 per cent.), while a granulation spot will react well to superficial cauterization with trichloracetic acid.

Some cases, however, prove rebellious. In most of these the hindrance to a cure will be found in structural configuration, causing either stenosis or local damming up of pus. Some of these lesions should receive surgical attention at once—for instance, papillomatous tumors, polypi, and flabby hypertrophies of the turbinals; especially, however, any existing hypertrophy of the pharyngeal tonsil. The same statement applies to deformities of the septum of sufficient degree to cause stenosis; but in the case of septum deviations or ridges of minor degree, an individual study and a proper trial of irrigation should precede the decision to resort to operative measures.

Besides the atypical form of purulent rhinitis just described, some more definitely characterized varieties may be recognized.

**35.** The **subacute rhinitis of scrofulous children** begins as a mild or subacute nasal suppuration, and persists until mild weather arrives or until it is successfully treated; often, however, it recurs the next season. The subjects are typically scrofulous young children with tubercular glands in the neck. The discharge is relatively thin, mucopurulent, and leads to excoriations and eczema below the nose. There is, as a rule, moderate enlargement of the pharyngeal tonsil; rarely, excessive nasal obstruction. The disease is often associated with phlyctenular keratoconjunctivitis, and frequently causes purulent otitis. A cure is sometimes obtained by better protection and healing of the excoriations under the nose by silver nitrate (10 per cent.) applications, followed by a zinc or ichthyol-lanolin salve or oil of cade. Cod-

liver oil is generally of benefit. The same may be said of all hygienic measures directed against scrofula, such as fresh air, baths, and proper feeding. The douche is very useful, unless a hypertrophic pharyngeal tonsil contraindicates its use, in which case a spray must take its place. Any enlargement of the pharyngeal tonsil that causes symptoms of obstruction calls for its removal. This does not, however, necessarily cure the rhinitis, although always of beneficial influence. As the children approach puberty the relapses cease.

**36.** Another variety has been named "**purulent rhinitis of children**" (Bosworth). It is a typical, but not very common, affection. Its subjects are not necessarily scrofulous. It begins early in childhood, and if not checked, persists during adolescence. In a few instances the author has known it to cease spontaneously. The discharge is thick, very profuse, not fetid, and but little influenced by the season. Examination, difficult in children, does not show the origin of this profuse flow of mucopus. It begins before the accessory cavities are well developed. The nasal lining appears pale. The passages are, as a rule, roomy, especially the pharynx. The pharyngeal tonsil is often normal. When enlarged, its removal, even if otherwise indicated, does not diminish the secretion of pus, at least not for many weeks, perhaps ultimately. Like all purulent nasal affections, it menaces the ear, often leading to purulent otitis with tendency to relapses. A view expressed by Bosworth that this form of purulent rhinitis may be the first stage of ozena has not been confirmed by any one, and was disproved in the author's experience by several observations continued through a number of years. The disease can be cured by the persistent use of the douche for many months.

**37.** Nasal suppuration was not distinguished sharply from the non-suppurative forms of rhinitis in former text-books. It is only within the last ten years that it has been shown by Ziem, and later by others, especially Grünwald, that many cases of so-

called purulent rhinitis are really sinus affections. Perhaps the clearest exposition of suppurative affections of the nose and its adjoining cavities can be found in Grünwald's *Lehre von den Naseneiterungen*, second edition, 1896 (American edition, *Treatise on Nasal Suppuration*, 1900). The purulent rhinitis of children was described by Bosworth in his *Diseases of the Nose and Throat*, 1889. The form I have described as subacute rhinitis of scrofulous children has not been differentiated clearly, except by Klemperer in Heymann's *Handbuch der Laryngologie*, etc. It is, however, a clinical picture quite familiar to ophthalmologists.

## CHAPTER VI.

### DISEASES OF THE NASAL ACCESSORY CAVITIES.

**38.** In communication with the nasal passages are the six hollow sinuses or cavities—viz., in the superior maxillary, the frontal and the sphenoid bones, as well as a series of cellular spaces in the ethmoid bone. They are all lined by a thin mucous membrane continuous with that of the nose and inseparable from the periosteal lining. Nothing is known concerning the utility of these spaces, except that they lessen the weight of the head. While only the severest type of disease of the sinuses was formerly recognized as a very rare surgical accident, it has been learned within the past ten years that affections of these spaces are very common. Their remarkable frequency has been shown even more strikingly by autopsies than by clinical experience. Systematic researches have been made on the postmortem table by Harke, E. Fränkel, Dmochowski, Wolff, Pierce, and others. It has thus been shown that one or more of the sinuses are found diseased in nearly one-half of unselected subjects dead from different causes. In diseases of the respiratory passages the ratio is even higher, and in infectious diseases, like diphtheria and scarlet fever, involvement of some of the cavities is almost the invariable rule. The sinus involved most commonly is the maxillary antrum; about one-half as often the sphenoid cavity is found diseased, while the frontal sinus suffers relatively rarely. The ethmoid cells have not been examined to the same extent, and there is some discrepancy as regards the frequency of their involvement by different authors. They are evidently much less often diseased than the maxillary sinus. Relatively common is multiple disease of several sinuses.

The lesions found vary from a mild superficial to a

deep-seated inflammation, with more or less loss of epithelium and sometimes with membranous formation, while the contents of these spaces may be a turbid serum or pure pus. There is usually much inflammatory edema present.

The involvement of the accessory cavities in severe systemic disease occurs either but shortly before death, or produces so little symptomatic manifestation that it has hitherto been practically overlooked clinically, as acute affections of the sinuses are not often seen clinically, while of the chronic instances only a moderate proportion can be traced to some previous general disease. Still, among the patients presenting a purulent discharge from the nose a large number really suffer from disease of one or the other sinus.

**39. Symptoms of Sinus Disease.**—Prominent among the symptoms of acute sinus disease is **pain.** This may occur in the form of headache, especially in the case of the sphenoid and ethmoid spaces. Disease of the frontal sinus commonly causes supra-orbital neuralgia or temporal headache—one-sided if the lesion is unilateral. Inflammation of the maxillary sinus produces infra-orbital neuralgia and pain in the teeth of the upper jaw. The localization of the pain is, however, not absolutely diagnostic of the sinus involved. Corresponding to the seat of disease are spots of tenderness during the acute period —viz., over and under the brow when the frontal sinus suffers, and under the orbit when the maxillary space is involved. In chronic instances the same forms of headache and of neuralgia may be present, especially in neurotic subjects, but they are not so constant. Suppuration of the ethmoid and sphenoid cells is at times the source of periodic attacks of migrain. Sometimes chronic sinuitis is not attended by pain, especially when the escape of pus is not obstructed. Patients with sinuitis are often noticeably intolerant to alcohol. Pronounced **mental depression** is not uncommon.

At its onset acute sinuitis causes the systemic dis-

comforts of infectious disease—viz., **slight fever, lassitude,** and **loss of appetite.** In chronic cases, too, **systemic affection** may occur in the form of stomach disturbance, perhaps due to the swallowing of the discharge, as well as loss of vigor and general malnutrition. Continued suppuration may lead to **neurasthenia,** especially when pain helps to depress the nervous system. The direct nasal symptoms of sinus disease are more or less **obstruction**—its degree dependent upon the width of the passage—and purulent discharge. The latter may be very slight or extremely copious, bland or foul. Some patients pay no attention to the slight discharge; in others it may drop into the pharynx. Not rarely **nasal lesions** are associated with sinus disease, such as purulent or hypertrophic rhinitis, and especially polypi. These lesions are either the consequence of sinus suppuration, or, if preexistent, are a predisposing condition. The latter statement applies especially to ozena. Often, too, sinus inflammation leads ultimately to disease of the pharynx or larynx or the bronchial tubes. Occasionally inflammation of a cavity, especially the ethmoid cells, is the starting-point of asthma.

**Complications.**—Among the dangers of all sinus disease are the possible invasion of, or influence upon, adjoining organs. The **ear** may suffer from acute purulent otitis or serous catarrh. Extension toward the **eye** may involve the tear-passages in the form of purulent inflammation. Suppuration of either the frontal or the ethmoid cavities may lead to bulging of the orbital wall of these spaces, simulating an orbital abscess. More serious is the actual perforation of this wall, with invasion of the orbit itself, although the true orbital abscess may also follow a benign course. Some of the intra-ocular tissues sometimes suffer in consequence of different forms of sinuitis. In the course of ethmoid or maxillary suppuration iritis of a very persistent character with great liability to relapse may occur. Atypical forms of chorioretinitis and of exudative choroiditis have also been

observed as a complication of these sinus diseases. Suppuration of the sphenoid space has in rare instances led to inflammatory involvement or to atrophy of the optic nerve, separated from the sinus only by bony walls of variable thinness. Any form of sinus disease may result in irritability of the eyes and obstinate asthenopia.

Deaths have been recorded in moderate number in consequence of extension of sinus disease to the brain. This, however, is not a frequent accident and does not apply to disease of the maxillary sinus.

**Pathology.**—The lesions in acute sinuitis as observed at autopsies vary from a superficial inflammation to an involvement of the deep periosteal layer, with more or less edema and sometimes ecchymoses. The epithelium may be intact or partially lost. Croupous and pseudodiphtheritic inflammation is less common. In chronic cases studied during operations the mucous membrane is usually found thickened; occasionally, in a state of cystoid degeneration; in other instances, tough and sclerosed. Polypi are not often met with. Prolonged deep inflammation may lead to roughening of the bone by the formation of osteophytes. Granulation tissue is quite commonly found. When pus exudes on curetting these granulations, caries of the bony wall exists underneath, but this is a relatively rare lesion. Occasionally necrotic sequestra of bone have been seen.

Dilatation of a sinus with bulging of one of its walls occurs not very rarely in the case of the frontal and ethmoid cavities, evidently on account of an occluded orifice. Sometimes the contents are turbid or even clear mucus, and the process is due to retention without pyogenic infection. This condition has been termed hydrops or mucocele. In other instances pyogenic influences complicate and pus is present, usually with decided tendency to spontaneous perforation. Hydrops of the maxillary sinus is likewise a not uncommon occurrence, but does not cause bulging of its walls. Indeed, the

only disease that leads to visible distention of the maxillary cavity is the presence of dental cysts in its interior.

**Etiology.**—Autopsies have shown that the most common causes of sinus disease are severe systemic affections or the terminal infections that produce death. Although pathologists state that commonly there are no nasal lesions in such cases, it is more logical to assume that the infection occurs oftener through the nasal orifice of the sinus than by way of the blood current. Fatal diphtheria produces, invariably, fatal influenza, scarlet fever, and measles, quite commonly disease of one or more of the cavities. This involvement is more often due to secondary infections than to the specific parasites of the original disease.

But of the sinus affections thus produced, relatively few are observed clinically. If the patient does not die, most of these forms of sinus affection get well spontaneously. It is evident clinically that the spontaneous recovery is hindered by any conditions interfering with drainage, such as coexisting intranasal lesions. The larger proportion of the clinical cases of sinus disease can be traced to the time of a severe nasal inflammation, either simple coryza or more often the nasal affection during the course of an influenza, pneumonia, typhoid fever, scarlet fever, or measles. Less commonly syphilitic nasal disease is the original cause. Relatively often the cavities become involved in the course of ozena. Disease of the higher sinuses may spread into the maxillary cavity secondarily. Traumatism plays a minor rôle. Intranasal cauterization occasionally causes maxillary or frontal involvement. A large minority of the maxillary cases can be traced to defective teeth.

The parasites found—and presumably the cause of sinus disease—are pneumococci, staphylococci (different varieties), streptococci, pseudodiphtheria bacilli, coli bacilli, and the bacillus mucosus capsulatus (ozena), often in combination. In influenza the influenza bacillus has been found less often than other parasites. Diphtheria of the

nose causes always diphtheritic infection of some sinuses (in fatal cases), whereas diphtheria of the throat leads to sinus disease, but not necessarily to diphtheritic infection of the sinus. There is good reason to believe that the long-continued contagiousness of convalescent diphtheria patients is partly due to the persistence of the germs in one or the other sinus.

**40. Diagnosis.**—The diagnosis of any sinus suppuration depends upon the demonstration of the discharge. It is sometimes very difficult to trace the pus to its source. The frontal and the maxillary sinus and the anterior ethmoid cells empty their morbid contents underneath the middle turbinal near its anterior end. The posterior ethmoid cells and the sphenoid sinus discharge through the space between the middle turbinal and septum. When the nose is filled with pus, this must be partly removed by mopping before the path of entrance can be traced. If no secretion can be seen, the douche will bring out any discharge, which must be sought in the basin. In doubtful cases tampons may be left in the middle meatus or between the middle turbinal and the septum for a short time and then examined. Probing through the natural orifices is difficult, but generally possible in the case of the sphenoid sinus; less successful in the case of the frontal sinus, but very uncertain so far as the other cavities are concerned. Attempts may be made to dislodge pus by directing a stream through a narrow cannula toward the natural orifice of the suspected space. Maxillary suppuration can usually be demonstrated by translumination (see ¶ 49). In doubtful instances the diagnosis can be made certain only by an exploratory puncture.

**41. Treatment.**—The treatment of acute cases may be expectant unless urgent symptoms indicate immediate operation. Probably most acute cases heal spontaneously. The healing is favored by all measures that facilitate drainage, such as the use of the douche and frequent spraying by the patient, as well as applications of cocain

or suprarenal solution, while obstructive lesions should receive due and, if necessary, surgical attention. The acute pain can generally be checked by antipyrin. Neuralgic pains, if not permanently controlled by antipyrin, are often cured by the use of quinin in large doses (0.4 to 0.6 twice a day). All chronic cases, however, in which a purulent discharge has persisted for many weeks require operative interference.

While the special operations required for the different sinuses will be described in connection with each, a procedure applicable in disease of the anterior ethmoid cells, the frontal and the maxillary sinus, can be detailed at

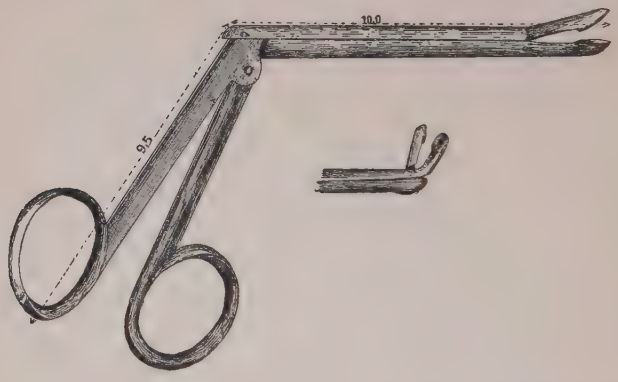



FIG. 33.—Grünwald's cutting forceps for operation on the middle turbinal.

present. It is **resection of the front end of the middle turbinal,** as advocated by Grünwald. By the removal of this overhanging ledge the nasal side of the orifice of the spaces is made accessible. The middle turbinal cannot always be grasped sufficiently by the wire loop of the snare to be removed satisfactorily. Hence Grünwald cuts the front part of its lateral attachment with a specially designed forceps (Fig. 33). Any cutting forceps, however, of such shape as to reach this locality can be substituted. The snare loop can now be slid through the gap, and the front end of the bony lamella may thus be snared off. When the lateral insertion cannot be reached

easily by forceps on account of its height, the author has cut a vertical gap through the middle turbinal, 1 to 2 cm. behind its front end, and then grasped the anterior extremity with the snare through this gap, thus letting the wire cut horizontally instead of vertically, as Grünwald advocates.

**History and Literature.**—Prior to 1880 the literature of sinus affections consisted mainly in the reports of isolated cases of sufficient severity to make the diagnosis a simple matter. The frequency of empyema of the maxillary sinus, foreshadowed in dental literature, was emphasized by Ziem, a personal sufferer from that disease, in many reports since 1880. Attention was called to ethmoid disease by Woakes, the value of whose clinical observations was impaired by false pathologic notions concerning "necrosing ethmoiditis." Numerous reports scattered throughout periodic literature gradually helped to establish the clinical picture of sinuitis. Disease of the frontal sinus was well described and appropriately treated in Kuhnt's treatise (*Ueber die entzündlichen Erkrankungen der Stirnhöhlen und ihre Folgezustände*, 1895). Extensive autopsy reports began with Weichselbaum, but especially Harke (*Beiträge zu Pathologie der oberen Athmungswege*, 1895), and were extended by E. Fränkel and others. The most complete reviews of the entire subject are found in Grünwald's *Treatise on Nasal Suppuration*, Killian's articles in Heyman's *Handbuch der Laryngologie*, etc., but especially to be recommended is Hajek's *Pathologie und Therapie der Nebenhöhlen der Nase* (1899). The last-named treatise and Zuckerkandl's *Anatomie der Nasenhöhle* are the best sources of anatomic information.

## ANATOMY OF THE NASAL ACCESSORY CAVITIES AND THEIR TOPOGRAPHIC RELATION TO THE NASAL PASSAGES.

**42.** The pneumatic spaces known as the nasal sinuses surround the external wall and partly the roof of the nasal cavity. The roof begins with the awning-shaped covering of the vestibule formed by the nasal bones. The nasal cavity proper is closed above by the ethmoid bone anteriorly, and by the body of the sphenoid bone posteriorly. The distance from the floor to the roof underneath the horizontal plate of the ethmoid is from 38 to 50 mm. Posterior to the ethmoid the front surface

of the sphenoid body falls off vertically, with a backward slant, and thus shortens the nasal height about 15 mm., while, by reason of the downward slope of the lower surface of the sphenoid, the vertical diameter of the nose continues to diminish toward the posterior choanæ. Of that part of the roof formed by the horizontal or cribriform plate of the ethmoid only about 2 to 3 mm. are accessible on each side of the septum, as the various ethmoid lamellæ that form the labyrinth reduce the width of the olfactory fissure to that extent. Underneath the sphenoid the width of the roof is determined by the breadth of the inferior surface of the sphenoid bone. The variable thinness of the ethmoid roof that separates the nose from the intracranial cavity enjoins the utmost caution in operations near the roof.

The external wall of the nasal passage is formed in its anterior two-thirds by the nasal surface of the superior maxillary below and by the lamina papyracea of the ethmoid bone above, while the posterior third is made up of the vertical plate of the palate bone. The nasal width between the external walls diminishes upward, but the nasal passage itself is very much narrowed by the turbinated processes. The turbinated bone (inferior turbinal) runs as a ledge from about 1 cm. behind the nasal aperture to the posterior choanæ. By its external articulation it is attached to the maxillary as well as the palate bones. This thin curved and partly rolled lamina presents its convexity upward and inward. Its posterior end appears broadened by reason of its curve. The delicacy of this bony ledge is hidden by the thick and turgescent mucous membrane covering it. Nearly parallel with and above the inferior turbinal is the middle turbinal, beginning anteriorly about 1 cm. behind the lower one, which it resembles in shape. The middle turbinal, however, originates from the lamina papyracea of the ethmoid, but extends beyond that bone posteriorly to the posterior choanæ. Between it and the external wall are other bony processes of the ethmoid, to be described later.

Above it, too, are additional laminæ from the ethmoid bone projecting like the middle turbinal inward and downward. All of these offshoots of the ethmoid narrow

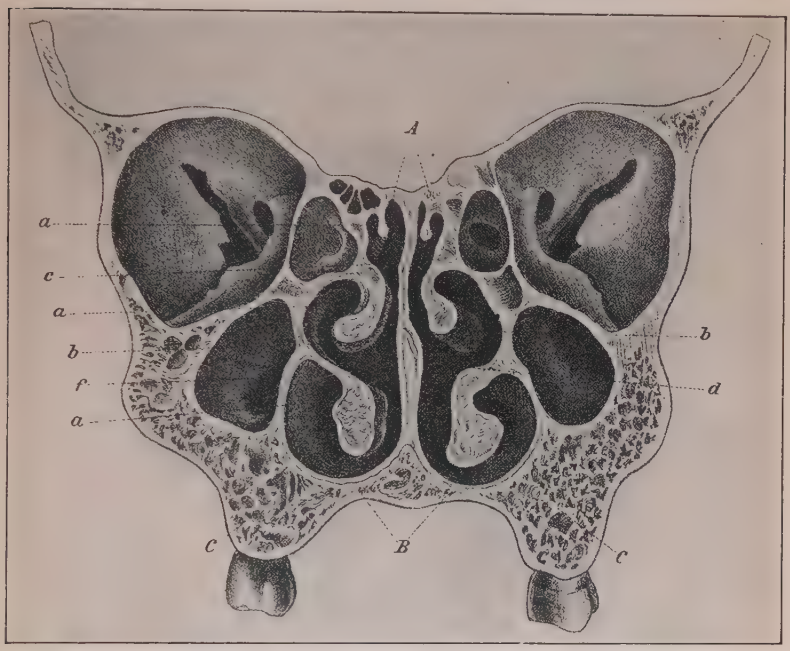



FIG. 34.—Frontal section through the rear part of the nasal passages: *A*, Roof; *B*, floor; *b*, external wall of nasal passages; *C*, alveolar process, high and spongy; *a*, *a*, *a*, the three nasal meati; *b*, middle turbinal; *c*, olfactory fissure; *d*, respiratory fissure (Zuckerkandl).

the upper part of the nasal passage to the width of the olfactory fissure (Fig. 34).

## ETHMOID CELLS.

**43.** The key to the complicated architecture of the nasal cavity and its sinuses is furnished by the anatomy of the ethmoid bone (Fig. 35). Its horizontal or cribriform plate (lamina cribrosa) separates the nasal from the intracranial cavity. Its width corresponds to the space between the internal boundaries of the orbits. From this plate descends centrally and vertically the perpendicular

lamina, which, by articulating with the nasal bones in front and with the anterior surface of the sphenoid body behind, forms the upper part of the nasal septum.

Above the cribriform plate the prolongation of the perpendicular lamella extends into the cranial cavity as a short sharp ridge—the crista galli. The lateral surface of the ethmoid bone is formed by the thin, nearly vertical lamina papyracea, which constitutes the internal wall of

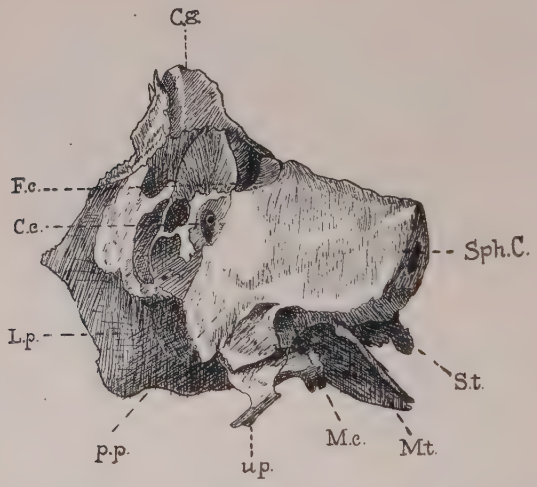



FIG. 35.—Ethmoid bone seen from the left side: *p*, *p*, The orbital surface of the lamina papyracea; *C. g*, crista galli; *F. c*, frontal cellules; *C. c*, lacrimal cellules; *L. p*, perpendicular plate; *u. p*, uncinate process; *M. c*, maxillary cellules; *M. t*, middle turbinal process; *S. t*, superior turbinal process; *Sph. C*, sphenoid cellules.

the orbit. This plate does not join the lamina cribrosa. Instead of a sharp edge, which would be formed by the junction of upper and external sides, the ethmoid bone presents here a series of pneumatic cells (foveolæ ethmoidales) open in the macerated specimen, but closed *in situ* by articulation with the correspondingly hollowed margin of the orbital plate of the frontal bone (Fig. 36). Downward the lamina papyracea extends to the (nasal) border of the orbital process of the superior maxilla.

The two laminæ papyracea diverge slightly downward and backward.

From the internal face of the lamina papyracea arise a series of more or less concentric, shelf-like lamellæ, the ethmoturbinal processes. Their attachment to the lamina papyracea describes a slight curve with its convexity downward from the anterior upper end to the inferior lower termination. In transverse (frontal) section all these processes appear curving downward so as to form overhanging ledges. The three lowest processes—viz.,

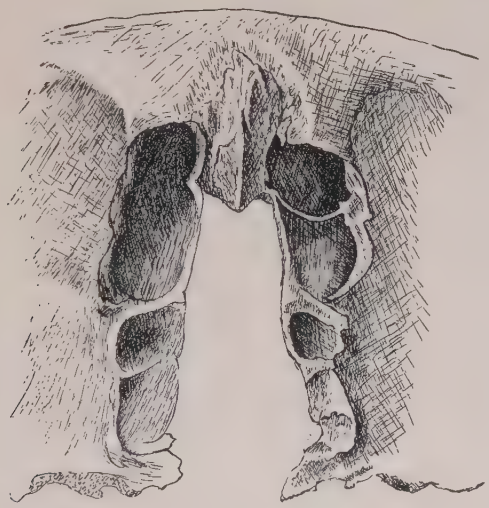


FIG. 36.—View of the frontal bone from the pyriform incisure, showing the pneumatic spaces which form part of the upper ethmoid cells (Hajek).

the uncinate process, ethmoid bulla, and middle turbinal —extend downward below the inferior margin of the lamina papyracea, so as to cover a part of the gap in the nasal surface of the superior maxilla.

The lowest ethmoturbinal lamella is the uncinate process (Fig. 37). This delicate broad-sword or sickle-shaped bony lamina does not arise from the lamina papyracea itself, but from the anterior expansion of the middle turbinal process, where the latter articulates with the frontal process of the superior maxillary bone.

It proceeds backward and somewhat downward in a plane not quite vertical, as its upper concave edge points toward the maxillary sinus. Near its rear end this process is attached by delicate prolongations to an upward extension of the inferior turbinal bone and to the roof of the maxillary sinus. The internal or nasal wall of the maxillary sinus has a large aperture in its upper part in the skeleton. The space between the lower border of the

FIG. 37.—External wall of the right nasal passage: *B*, Bulla ethmoidalis; *p*, uncinate process; *H*, hiatus semilunaris; *S*, sinus within the bulla ethmoidalis (Zuckerkandl).

uncinate process and the lower rim of this bony aperture in the maxillary wall is closed by the junction of the mucous membrane of the nose and of the maxillary sinus, which two linings are here inseparable. This membranous wall, containing some vertical bridges formed by slender spicules of bone, is termed the nasal fontanel.

Above (and behind) the uncinate process there springs from the lamina papyracea a thicker but hollow bony ledge, likewise slightly slanting inward from the vertical

plane—the bulla ethmoidalis. Its interior cavity has an opening behind. Between the uncinate process and the bulla there is a curved cleft—the hiatus semilunaris. This cleft is the entrance into a funnel-shaped space of a depth variable up to 1 cm.,—the infundibulum,—at the bottom (external side) of which are the orifices of the frontal and the maxillary sinus. This space, as well as all the recesses to be described, is lined by the nasal mucous membrane, which passes uninterruptedly through the orifices into the different sinuses, but in these spaces does not retain the thickness and the venous plexus which it possesses in the nasal cavity.

Above the bulla another ledge springs from the lamina papyracea—the middle turbinal. This passes inward and then curves downward like a cornice, so as to cover completely the hiatus semilunaris. The middle turbinal extends beyond the lamina papyracea backward and somewhat downward, reaching thus underneath the inferior surface of the sphenoid body up to the rear end of the nasal passage.

The spaces between the uncinate process and bulla and middle turbinal form the *anterior ethmoid cells*. These recesses open thus into the middle meatus of the nose underneath and external to the middle turbinal.

Above the middle turbinal, and somewhat back of it, another ledge arises from the lamina papyracea, the superior turbinal, while finally and uppermost another bony lamella springs from the horizontal plate of the ethmoid—the supreme turbinal. These thin bony ledges all curve downward with edges more or less rolled, forming the upper ethmoturbinal processes. The spaces inclosed between them are the *posterior ethmoid cells*, which open into the olfactory fissure between the middle turbinal and septum (Fig. 38).

The architecture of the ethmoid cells is complicated by the variable curvature and irregular shape of the turbinal ledges, but especially by incomplete bony or membranous septa subdividing these longitudinal pass-

ages into a series of communicating cells of variable size and number. These cells constitute the ethmoid labyrinth. All these spaces are lined with a continuation of the nasal mucous membrane. The bony frame of the

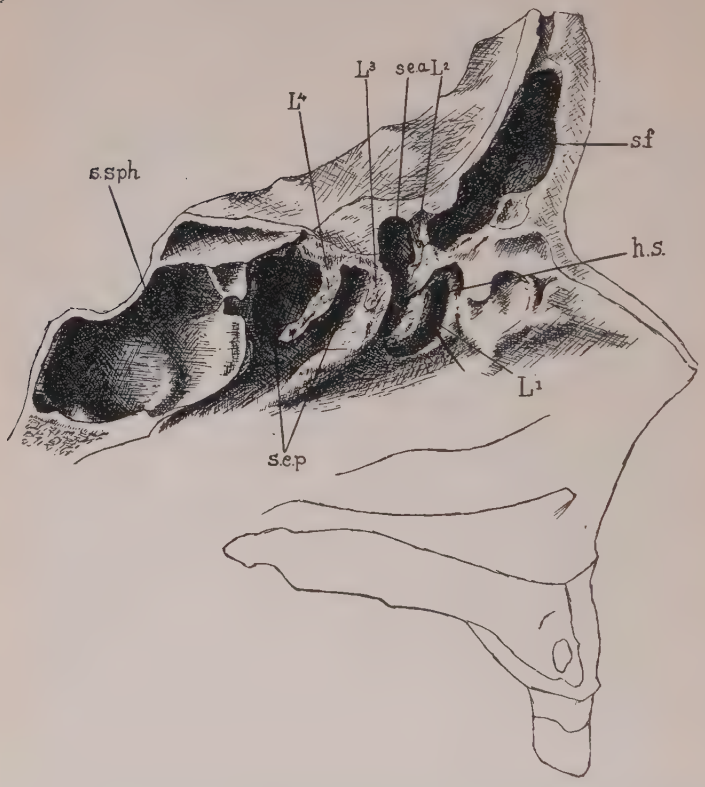



FIG. 38.—Ethmoid labyrinth from the nasal side, with demonstration of the main lamellæ: *s. f*, Frontal sinus; *s. sph*, sphenoid sinus; $L^1$, the first lamella, the uncinate process; $L^2$, the second lamella, the bulba ethmoidalis; *h. s*, hiatus semilunaris; $L^3$, the third lamella, the main lamella of the middle turbinal; *s. e. a*, anterior ethmoid cell; $L^4$, the fourth lamella, the main lamella of the superior concha; *s. e. p*, posterior ethmoid cells (Hajek).

middle turbinal broadens in its anterior part by becoming cancellated. The deeper (periosteal) layer of the mucous membrane dips into the spaces between the bone-plates and assumes a medullary structure rich in fat-cells. In

some instances pneumatic cells extend into the middle turbinal process.

The number and, conversely, the size of the individual ethmoid cells vary considerably. In rare instances there are only a few large spaces. The relation in size of anterior to posterior cells is also variable and depends on the site of the middle turbinal, which divides the two sets of cells from each other. The ethmoid

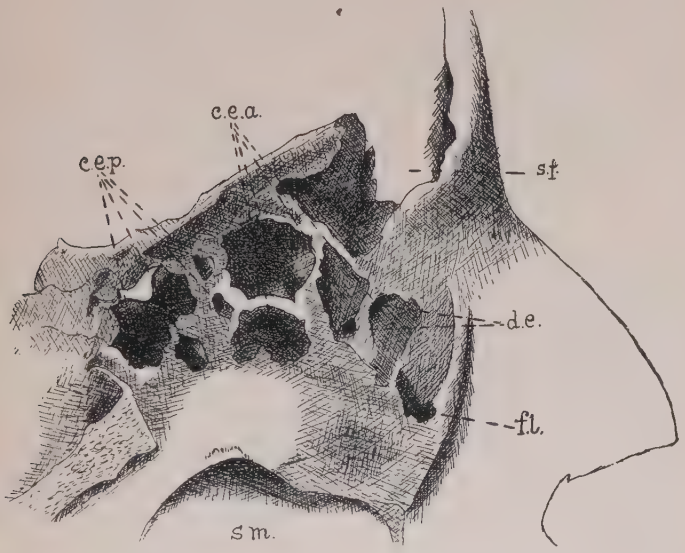



FIG. 39.—Large frontal sinus; the ethmoid labyrinth exposed through the lamina papyracea: *s. f*, Frontal sinus; *f. l*, lachrymal fossa; *s. m*, maxillary sinus; *c. e. a*, anterior ethmoid cells (4); *c. e. p*, posterior ethmoid cells (4); *d. e*, nasal orifices of ethmoid cells (Hajek).

bulla is occasionally enlarged and expanded, sometimes to an extent to become visible on anterior inspection. Its enlargement is apt to cause one or more of the foremost cellular spaces to intrude into the frontal sinus. On the other hand, the rear cell of the posterior set may also intrude into the sphenoid sinus (Fig. 39).

The orifices of the anterior ethmoid cells, variable in number on account of the variability in the size and

intercommunications of the cells, open usually between bulla and middle turbinal. The posterior cells present small openings along the external wall of the superior nasal meatus.

## FRONTAL SINUS.

**44.** The frontal sinus is an irregularly shaped cavity in the frontal bone above and between the orbits. It is variable in size and extent, usually larger in the male than in the female (Figs. 40 and 41). Scarcely developed at birth, it grows slowly until puberty, when it is only about the size of a pea, after which period it rapidly gains

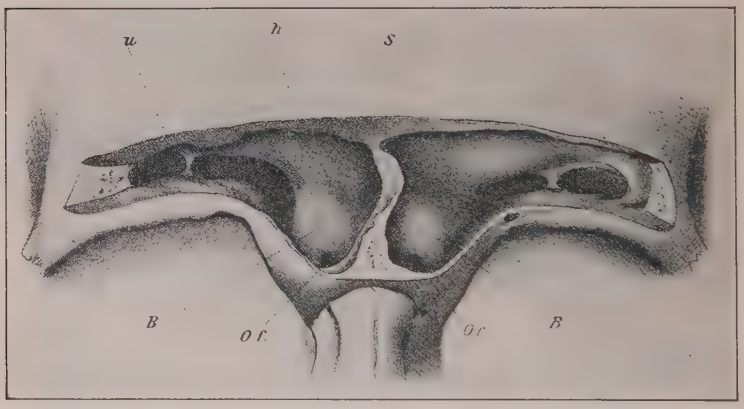



FIG. 40.—Frontal bone, the external plate removed to show the frontal sinus: *u*, Lower wall, *h*, posterior wall, of frontal sinus; *s*, frontal septum; *o. f*, frontal orifice; *B*, bulba frontalis (Zuckerkandl).

its full development. The two sinuses are separated by a median partition occasionally curved and asymmetric. The vertical height close to the septum is between 28 and 40 mm. The anteroposterior depth is determined to some extent by the prominence of the brow. It may extend backward as far as the middle of the orbit or even beyond. More variable even is the transverse width of the two spaces, which oscillates between 20 and 75 mm. Sometimes one or both cavities are rudimentary or even obliterated. The anterior wall is generally quite thick. The floor formed by the upper, and to some extent by

the inner, orbital wall is the thinnest boundary. Occasionally a sinus is incompletely subdivided by bony partitions. At the lowest part of the floor is the orifice of the nasofrontal duct, a short, funnel-shaped opening. The distance between the orifices of the two frontal sinuses is determined by the width of the ethmoid bone.

FIG. 41.—Sagittal section through frontal sinus: *S*, Frontal sinus; *b*, frontal bulla; *s*, sinus within frontal bulla; *B*, bulla ethmoidalis; *P*, uncinate process; *H*, sinus between anterior insertion of the middle turbinal and the uncinate process (Zuckerkandl).

The nasal entrance is usually at the anterior end of the hiatus semilunaris, between the uncinate process and bulla of the ethmoid, sometimes, however, anterior to it, but always underneath and hidden by the front end of the middle turbinal. Occasionally an anterior ethmoid cell protrudes into a frontal sinus.

## SPHENOID SINUS.

**45.** The sphenoid sinus is the cavity in the interior of the body of the sphenoid bone, separated by a median and

not always symmetric wall into two non-communicating spaces (Fig. 42). This sinus varies in height from 13 to 27 mm.; in length, from 10 to 28 mm.; and in width, each from 10 to over 25 mm. (by extension into the lesser wing of the sphenoid bone). It is rudimentary during early childhood. Bony partitions sometimes subdivide

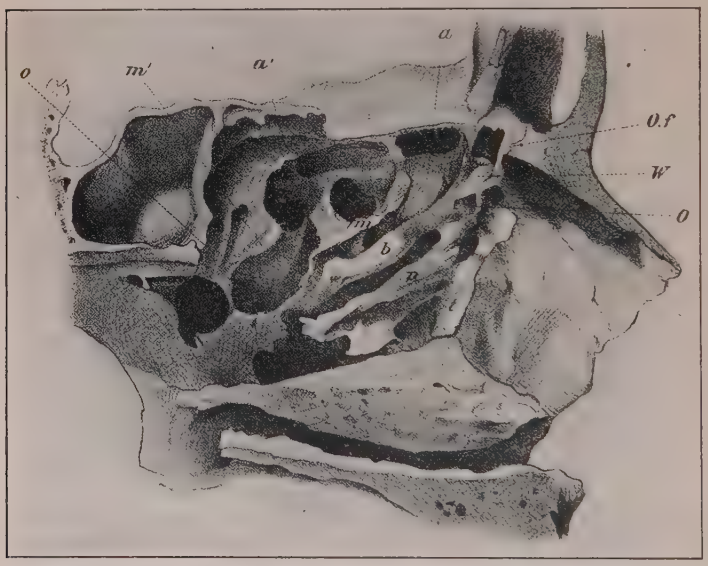



FIG. 42.—External wall of left nasal passage: *b*, Bulla ethmoidalis; *p*, uncinate process; *t*, lachrymal bone; *W*, superior vault of the hiatus projecting toward the frontal sinus; *O*, nasal orifice of frontal sinus; *O. f*, passage into frontal sinus partially opened; *m*, middle turbinal; *m'*, middle ethmoturbinal; *O*, superior ethmoturbinal; *a*, fissure between bulla ethmoidalis and middle turbinal leading into a sinus of the orbital part of the frontal bone; *a'*, cell between the middle turbinal and the anterior sphenoid surface, without partition between the two spaces (Zuckerkandl).

it into several spaces. The superior wall, usually solid, is sometimes imperfect, which may bring its mucous lining in contiguity with the dura mater, thus endangering the optic nerves above it in case of disease. The lateral walls are largely within the intracranial cavity. Adjoining them (above) are the internal carotid artery and the cavernous sinus. The inferior (nasal wall)

is the thinnest. The orifice of each sinus is situated in its anterior wall near the roof, in the space between the septum and the nasal surface of the ethmoid labyrinth. This opening, of good size in the skeleton, is narrowed by the mucous membrane and is sometimes reduced to a mere slit. It can be reached directly by a slender instru-

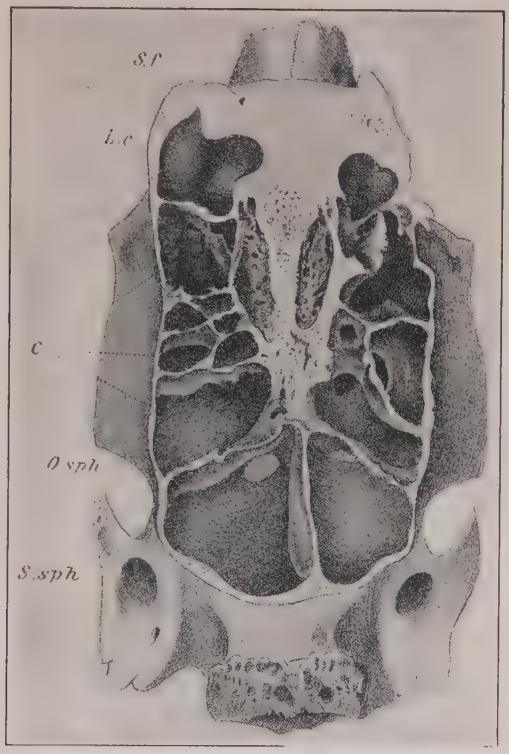



FIG. 43.—Horizontal section through the human frontal, ethmoid, and sphenoid bones: *S. f*, Frontal sinus; *L. c*, lamina cribrosa; *C*, ethmoid cells; *O. sph*, sphenoid orifice; *S. sph*, sphenoid sinus (Zuckerkandl).

ment inserted through the olfactory fissure. The distance from this orifice to the pyriform aperture of the nose has been found to vary from 60 mm. to 82 mm. in the living (Fig. 43).

Embryologically the sphenoid sinus is originally the upper rear portion of the olfactory fissure. The upper

rear ethmoturbinal (cartilaginous) lamella of each side changes during its ossification into a closed bony capsule, the sphenoid concha or ossicle of Bertinus. The inclosed space is the sphenoid sinus, which is thus separated from the nasal chamber at birth, though as yet very small. The body of the sphenoid bone behind it is small and solid. The sphenoid rostrum, however, is an extended partition and separates the capsules of the two sinuses.

About the fourth year the ossicles of Bertinus begin to atrophy, and the anterior surface of the sphenoid body curves around them by its growth on all sides except the median. About the tenth to the twelfth year the sphenoid conchæ have dwindled down to small triangular plates which, by their coalescence with the growing sphenoid walls, now form part of the anterior wall of the sinus, while all the other sides are now supplied by the sphenoid body itself. The rostrum has become the partition wall between the two sinuses. From this time until puberty the sinus completes its growth at a more rapid rate.

### MAXILLARY SINUS.

**46.** The maxillary sinus or antrum of Highmore is an irregularly shaped cavity in the interior of the superior maxillary bone, which can be approximately compared to a three-sided pyramid with base upward (the orbital floor), an external or facial, an internal or nasal, and a posterior side (Fig. 44). It is scarcely developed at birth, and does not reach its final size until after the second dentition. When well formed in the adult, its different dimensions range between 20 and 35 mm. But this cavity is not rarely diminished in size in one or the other direction by absorption of the cancellated bone tissue in the alveolar process or by the sinking-in of the facial wall, or at least its thinnest part,—the canine fossa,—or by the bulging of the nasal wall toward the sinus. All these conditions may coexist and, if combined with diffuse thickening of the bony walls, may in rare

instances almost obliterate the sinus. The encroachment upon the cavity by any considerable depression of the facial wall reveals itself in the architecture of the face, while unusual width of a nasal meatus also suggests stenosis of the maxillary sinus. The two cavities are not rarely asymmetric (Fig. 45). On the other hand,

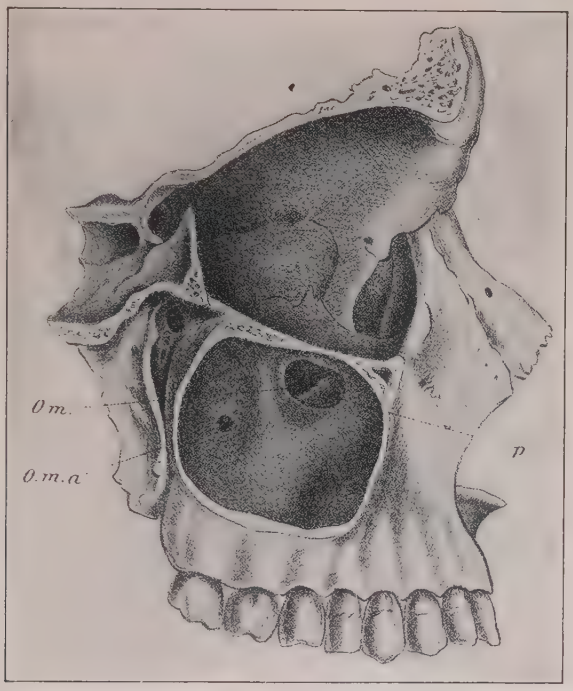



FIG. 44.—Right superior maxilla; antrum opened from the external side: *O. m* (large), maxillary orifice; *O. m. a*, accessory maxillary orifice; *p*, uncinate process (Zuckerkandl).

the space is often enlarged by the formation of niches or recesses in the solid bone, leading to the formation of an alveolar—palatal—infra-orbital or molar sinus, while in other instances the cell in the orbital process of the palate bone may constitute a posterior niche connected with the maxillary sinus. These recesses are sometimes spaced off by incomplete bony partitions. Occasionally

more or less complete bony septa, vertical or horizontal, divide the entire sinus into two separate chambers, each communicating with the nose.

The floor of the antrum, formed by the junction of the external and posterior walls, varies in width in different subjects, and is often reticulated by the prominences corresponding to the teeth beneath the floor. According to the degree of absorption of the cancellated tissue, the

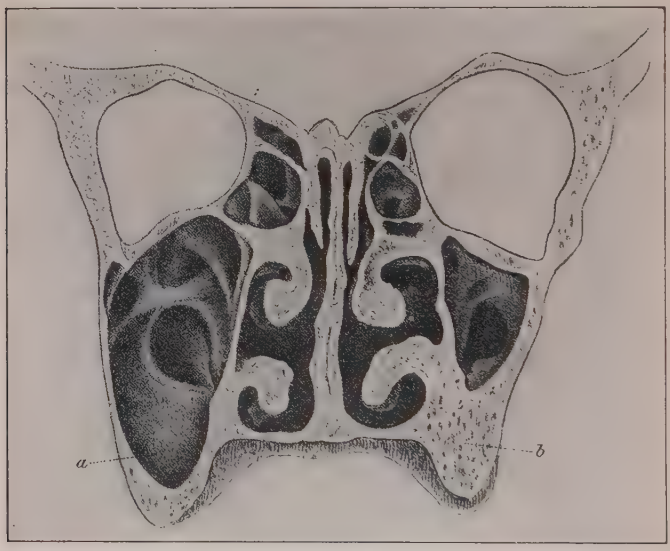



FIG. 45.—Asymmetry of the two maxillary sinuses. On the right side, at *a*, a deep alveolar recess, while on the left side the alveolar process, *b*, extends upward (Zuckerkandl).

roots of the teeth may project into the cavity or be separated from it by a thick alveolar process. The number of teeth below (or in) the floor of the antrum varies with the development of the alveolar and palatal niches. Zuckerkandl found in 26 skulls that the sinus reached from the last molar to the first molar 6 times, to the second bicuspid 3 times, to the first bicuspid 13 times, to the canine teeth 4 times. The infra-orbital canal, containing the infra-orbital nerve, which passes along the roof of the antrum, is partly deficient in some subjects, leaving the nerve exposed.

The opening between the nose and sinus is in the upper part of the nasal wall of the antrum, close to the roof or orbital wall of the sinus (see Fig. 37). It is usually oblong, its height ranging between 2 and 5 mm., and its length between 3 and 10 mm. But this opening leads only indirectly into the nose through the space called the infundibulum. The large aperture found in the upper half of the nasal wall of the macerated max-

FIG. 46.—*R*, Superior maxilla, nasal surface, the inferior concha partly resected in order to show the maxillary process: *P. m*, Maxillary process of the turbinated bone; *P. e*, ethmoid process of the turbinated bone; *P. l*, lachrymal process of the turbinated bone; *C. t*, turbinal crest of the palate bone; *C. e*, ethmoid crest of the palate bone; *C. e'*, ethmoid crest of the maxillary bone (Zuckerkandl).

illary bone is narrowed by the articulation below with the maxillary process of the inferior turbinated and the uncinate process, posteriorly with the vertical lamella of the palatal bone, and above with the hollow process of the ethmoid—the bulla ethmoidalis (Fig. 46). The latter forms a cornice slanting backward and somewhat downward on the nasal side of the sinus wall. The uncinate process of the ethmoid bone, shaped like a sickle, begins

in front and below the bulla, and, passing backward and somewhat downward, crosses the bony aperture and divides this opening into an anterior (lower) and a posterior (upper) half. The spaces between the uncinate process and the rim of the bony opening are closed by mucous membrane and constitute the nasal fontanels of the antrum, usually containing a few delicate bony bridges. Near the center of the upper or posterior fontanel, between the uncinate process and bulla, is the orifice of the maxillary sinus. The cornice-like projecting bulla and the uncinate process inclose between them a semilunar slit, a curved recess slanting backward and downward like the processes which surround it—of a width of from 2 to 6 mm. and a length of from 20 to 30 mm. This slit, the hiatus semilunaris, is the nasal gateway into the space between the bulla and uncinate process,—the infundibulum,—in the external wall of which the actual opening into the sinus is found. In the wider anterior portion of the infundibulum there is usually the orifice of the frontal sinus; sometimes, however, it is anterior to it. The aperture of the maxillary sinus is thus situated unfavorably for the escape of secretions, and every slight swelling of the mucous lining of the semilunar hiatus or of the infundibulum may shut off the communication between the nose and sinus. As the semilunar slit is completely covered by the middle turbinal, it is invisible during life. It is hence difficult and often impossible to enter it with instruments. A second accessory maxillary aperture is found in about 10 per cent. of subjects in either the upper or the lower fontanel, but is usually smaller than the principal orifice.

## CHAPTER VII.

### DISEASES OF THE MAXILLARY SINUS.

#### ACUTE MAXILLARY SINUITIS.

**47.** Acute inflammation of the maxillary sinus is clinically an occurrence of but moderate frequency, and not nearly so common as the findings of fresh lesions at autopsies. The clinical picture is, however, well defined and not difficult to recognize. It occurs either as the sequel of an acute nasal catarrh or an influenza rhinitis, or sometimes apparently primarily. In other less common instances the infection proceeds from diseased teeth. In rare instances the disease is brought about by intranasal operations, especially cauterization. Acute onset of moderate fever, with general malaise for a few days, disturbed appetite, and bad taste usher it in. As a rule, there is considerable infra-orbital pain, sometimes shooting into the teeth, and often supra-orbital pain and tenderness, suggesting involvement of the frontal sinus, which is not present. The cheek is tender to touch, sometimes slightly edematous.

The acute disease is usually one-sided. Free discharge of pus from one side of the nose occurs within the second day. Sometimes this is offensive from the start. Even if the pus is bland, the patient usually complains of a subjective bad smell.

The acute symptoms begin to subside in the course of about a week. In favorable cases the disease heals spontaneously in from three to six weeks. It is doubtful whether a spontaneous cure ever occurs in cases of dental origin. The liability to become chronic is increased by the coincidence of intranasal lesions causing stenosis.

The **diagnosis**, which is strongly suggested by the sub-

jective symptoms, is confirmed by the appearance of pus issuing from the middle nasal meatus. It may be verified by translumination (see ¶ 49). An exploratory puncture is scarcely ever needed for diagnostic purposes.

The **treatment** demands physical rest during the acute stage. Neuralgic pain can be suppressed by antipyrin or phenacetin, and, if these fail to give permanent relief, quinin, 0.4 to 0.6 gm., taken once or twice daily, in soft capsules, will usually succeed. The cure is facilitated by all measures favoring drainage, such as the douche, the use of sprays, and applications of cocain or suprarenal solution in the middle nasal meatus. As soon as the nasal tenderness has subsided an attempt may be made to inject salt solution through the natural maxillary opening (see ¶ 49). If this is successful, an exploratory puncture may be deferred as long as there is a history of steady improvement under the less active treatment. If, however, a series of days brings no decided improvement, irrigation may be practised through an exploratory puncture, and, if necessary, repeated a few times. Chronicity is sometimes due to irritation by inspissated pus, which can be removed by a single washing out. The details of the surgical technic will be described under the head of Chronic Inflammation. In cases of dental origin it is always necessary to extract the offending tooth, and generally best to puncture through the socket, with subsequent irrigation.

### CHRONIC INFLAMMATION OF THE MAXILLARY SINUS.

**48. Symptoms.**—Chronic suppuration of the maxillary sinus (empyema of the antrum of Highmore) is the most frequent cause of one-sided purulent discharge from the nose. In a small proportion of cases the disease is bilateral. The history is often vague. A few cases begin acutely, especially those due to carious teeth. But even the dental cases may be of insidious onset. While most acute inflammations, except those of dental origin, heal spontaneously, chronicity may be due to preexisting nasal

stenosis, to imperfect drainage on account of a small or swollen orifice, or to poor health in general. In many instances no acute history can be ascertained, and the lesion probably started in a subacute manner during the course of some infectious disease. Traumatism plays a very small rôle. Occasionally foreign bodies (snuff, vomited material) enter through the natural opening. More often foreign bodies get in through the surgeon's fault in the extraction of teeth or through exploratory openings made for acute disease and not properly guarded. Sometimes infection results from an intranasal operation, especially cauterization.

Chronic maxillary disease may remain latent for an indefinite period of time in some instances. Its only constant symptom is purulent discharge. This is sometimes so slight as to escape the patient's attention, or, guided by the shape of the nasal wall, it may flow into the pharynx. As a rule, however, it is the pus which annoys the patient. Sometimes the discharge is very profuse. It is more often foul than bland. Occasionally the discharge is but moderately offensive, while at the operation inspissated pus of intense fetor is met with. Either through absorption of toxins or by the swallowing of the pus, stomach disturbances and interference with nutrition may result. A bad taste, especially in the morning, is common.

Nasal obstruction by reason of turgescence becomes annoying in proportion to the narrowness of the nose. Even in the one-sided disease the stuffiness is more or less bilateral, but, of course, most marked on the narrow side. Sometimes there is pronounced nasal irritability, with sneezing fits. Asthma is an uncommon complication.

The occurrence of pain seems to depend on two factors —viz., interference with drainage by reason of hypertrophy around the hiatus semilunaris, and a neuropathic tendency. There may be headache, but more often infraorbital neuralgia or pain shooting into the teeth is com-

plained of, sometimes in periodically recurring attacks. One-sided disease produces one-sided pain. Tenderness of the cheek is not always marked.

While the disease may be combined accidentally with any form of nasal lesion, the intranasal affection most likely to be associated with it is polypoid hypertrophy around the hiatus semilunaris. This may not be visible until the front end of the middle turbinal is amputated. It can, however, be felt by the probe. Persistent profuse discharge generally leads to chronic rhinitis and pharyngitis, sometimes laryngitis. While the ear is menaced only indirectly by secondary nasal lesions, empyema of the maxillary sinus occasionally leads to eye complications, such as affections of the tear-passages, persistent and recurring iritis, and circumscribed forms of chorioretinitis.

Suppurative disease of the maxillary sinus causes no external signs, especially no distention of the sinus walls. When the latter occurs, it is always due to the presence of cysts.

The **lesions**, as observed at autopsies and after operations, are variable. During acute sinuitis inflammatory edema is commonly found. In chronic cases this may also persist, but oftener an actual hypertrophy of the mucous lining is found, characterized either by intense round-cell infiltration or later on by fibrillary sclerosis. The epithelium is mostly intact, but the surface is uneven, often warty. Polypi are not often seen. Pigmentary accumulations are common as the result of hemorrhages. Cysts due to dilatation of glands or to circumscribed interstitial edema are quite common. There may be granulation tissue in spots devoid of epithelium, usually indicative of lesions in the bony wall.

As the deeper layer of the mucous membrane constitutes the periosteum, the bony walls are apt to become involved in severe instances. The most frequent lesions are osteophytes like stalactites on the wall, sometimes even detached and loose. Much less common, but more

serious, is caries of the bone, which in rare instances may lead to perforation. Caries cannot be recognized with certainty by the use of the probe alone, on account of the roughness of the osteophytic surface.

**49.** The **diagnosis** is not always easy and may require repeated examinations. If pus is seen issuing from underneath the middle turbinal, it should be removed by mopping. A rapid reappearance of pus indicates that it comes from some reservoir opening in that region, which may be either the frontal sinus, the anterior ethmoid cells, or the maxillary sinus. The latter is the most frequent source. On account of the location of its orifice next to its roof, its contents do not escape during the erect posture except by overflow. If the head be turned so as to bring the orifice to the lowest level, a more rapid escape takes place, unless the fluid is very viscid or has been emptied just previously. Exploration of the orifice with a probe is possible only in a minority of instances. The probe should be bent at nearly right angles about 5 mm. from the tip. The middle meatus is cocainized, and by very gentle manipulation the probe is pushed through the opening in the hiatus semilunaris, or, to better advantage even, through the accessory orifice, if one is found posterior and a little below the hiatus. If pus is present, it will be found on the probe and along its track. If the probe can enter the orifice, an attempt may be made to irrigate through the same channel with a slender silver or rubber cannula shaped like the probe. Before this is done the nose must be cleansed completely by means of the douche. When irrigation through the orifice brings forth pus, the diagnosis is definite. The finding of pus in the antrum does not exclude purulent disease of the ethmoid cells, which may or may not be present as a complication.

**Translumination** is a valuable but not infallible diagnostic method. A miniature electric lamp of from 4 to 8 candle-power, mounted in a metal or rubber hood open on one side, is placed in the mouth, and the lips are

firmly closed. Any dental plate worn by the patient must previously be removed. The room must be absolutely dark, or a hood of opaque cloth may be placed over the heads of patient and examiner. When the current is turned on, a red glow is seen through the normal cheek and extending laterally in the shape of a butterfly's wing underneath the lower rim of the orbit. The two normal sides are generally symmetric. If, however, the maxillary sinus of one side is rudimentary and the cheek bone indented, the corresponding side may be darker than the other. When pus is present, the darkness of the affected side is unmistakable. Decided absence of translucency is a positive indication of maxillary disease. Either one-sided or double-sided sinuitis will rarely escape detection, but a moderate darkening may simply be due to denser structure of the bony walls. A diseased antrum, containing at the time but little pus or only a thin secretion, may give a doubtful indication. The diminished translucency in antrum diseases is, however, not due merely to the presence of pus, but also to changes in the mucous membrane—for, in pronounced instances, the red glow does not return at once after evacuation of the antrum.

When all other indications fail, the diagnosis can be established by an **exploratory puncture.** After cleansing the nose with a douche, a stout hollow needle is thrust through the external nasal wall into the sinus, 2.5 to 3 cm. behind the front end of the inferior turbinal. Above the inferior turbinal the nasal wall is membranous or contains but a thin lamella of bone. It is hence easily perforated; but if the nasal passage is very wide and the antrum small, care must be taken not to penetrate through the cavity into the orbital wall of the sinus. On the other hand, below the inferior turbinal the bony wall is so thick that much force is required, and some pain may be felt in spite of cocain. There is, however, scarcely any possibility of not striking the antrum if the needle is held as nearly transversely as the

space permits and is pointed upward. If it enters the nasal wall too far in front, it may penetrate through the anterior maxillary wall, and the subsequent injection may cause swelling and possibly infection of the cheek. When the socket of the second bicuspid or first or second molar tooth is available, the antrum can easily be reached by means of a small drill. An effort should first be made to blow out the secretion by means of an air-bulb, since a serous fluid would escape detection when mixed with water. Subsequently a stream of tepid sterile salt solution may be forced through the needle, and the escaping fluid caught as it flows from the nose.

**50. Treatment.**—It is doubtful whether a chronic maxillary empyema ever heals without evacuation even under favorable circumstances. The treatment, therefore, consists in the evacuation of the fluid. This may be attempted by irrigation through the natural or accessory orifice by means of a slender silver or rubber cannula bent near its tip. This procedure, only occasionally possible, is unreliable as to permanent effect. It is facilitated by the removal of the front end of the middle turbinal in case this operation is indicated by reason of hypertrophies in the middle meatus. If any of the upper teeth back of the incisors are diseased at their roots, tender to pressure or to heat or cold, their extraction is indispensable.

The easiest operation for draining the antrum is through the socket of an extracted tooth, preferably the first molar, or, if need be, the second molar or second bicuspid. It is rarely desirable to sacrifice a healthy tooth. A narrow orifice can be drilled on the internal side, between the two molars or first molar and bicuspid, but this opening has its drawbacks and is usually too small. The drilling can best be done with a drill attached to a dental motor. A conic hand drill can be used (Fig. 47) instead, but is more awkward where the alveolar process is thick. The hole should be at least 5 mm. wide. Cocain or nirvanin injected under the gums secures painlessness. The thickness of bone varies from

perhaps 2 to 8 or 10 mm. When the facial wall of the sinus is deeply sunken in, there is a small possibility of drilling from the alveolar socket through the canine fossa into the cheek. Perforating into the nose can happen only when the instrument is held too slanting and when the nasal meatus is excessively wide at the expense of the sinus. After irrigation the hole may be plugged with iodoform gauze for a day or two. Later a rubber plug or cannula should be fitted by a dentist. This must be guarded from slipping in by a thickened inferior edge, and will readily stay in place if slightly club-shaped at its upper end. If the plug is hollow, irrigation can be practised through it without the necessity of removing it every time. Food does not enter through a small opening. Without plug the fistula would close rapidly by

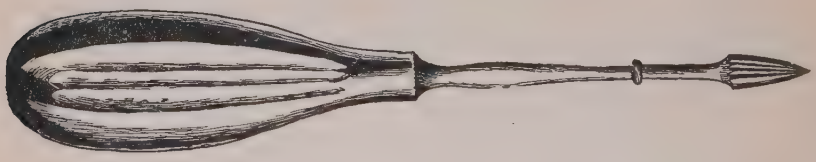


FIG. 47.—Hand drill for the maxillary antrum.

granulations. The patient learns easily to irrigate through the opening, using warm sterile salt or boric acid solution in a rubber bulb syringe with pointed nozzle. There is no natural drainage through the opening, as the fluid is too viscid, and the opening is not necessarily at the lowest point of the sinus.

The puncture through the alveolar process, known as Cowper's operation, gives immediate relief from all symptoms, but cures only a fair minority of cases, especially those of dental origin. If the secretion does not diminish steadily in the course of weeks, and has not ceased entirely after the lapse of from three to four months, no further improvement can be expected, except from a more radical operation. Comfort, however, can be secured as long as the opening is patent and irri-

gation is practised. When no more secretion is found, the opening should be maintained about two weeks for a further test before the plug or cannula is withdrawn permanently. If a scanty secretion still persists, it will become noticeable again during a week or two of intermission. Upon withdrawing the rubber plug the opening shrinks within about one week to a fine fistula, which then closes more slowly. If a foreign body gets into the sinus through the opening, the suppuration continues until it is removed.

**51.** Drainage into the inferior meatus of the nose is preferred by some operators to Cowper's operation. In several recent reports by German and American observers this operation has been highly praised, although most rhinologists have formerly found it objectionable. A stout curved trocar (Fig. 48) is thrust through the thick

FIG. 48.—Curved trocar for perforating the maxillary sinus through the nose.

nasal wall of the sinus underneath the inferior turbinal, and nearly 3 cm. behind its front end, the instrument pointing slightly upward. In spite of cocain this is apt to be painful. The opening has not so much tendency to shrink as the puncture through the alveolar socket. On the other hand, it is practically impossible to fit a cannula into it. It is more difficult for the patient and often more painful to learn to wash out the sinus through this opening. But it has been claimed recently that many cases heal even without irrigation, except during the first few days, if the opening is only kept patent. Insufflations of boric acid or iodoform have been practised with good results.

**52.** The obstacle to a permanent cure of maxillary empyema may be the existence of polypi or granulations in the sinus, or, less commonly, caries of its walls. Cases

not cured by irrigation through a small orifice require removal of the anterior wall. This procedure, known as Küster's operation, can be tolerated under cocain or nirvanin injection, but may require narcosis in the case of a timid person. A horizontal incision is made down to the bone below the canine fossa from the canine tooth to the second molar. At its front and rear ends the incision is curved upward in order to form a flap. The periosteum is detached upward, and the thin anterior wall of the sinus perforated either with a large trephine run by a motor or with a chisel. The opening is enlarged with bone nippers until a fair view can be had of the interior of the sinus. If the probe or inspection reveals no extensive changes in the interior, the operation may be considered finished. The view at the time is, however, often hindered by bleeding. A tampon of iodoform gauze is then inserted for a couple of days. After that time the interior can be inspected, and polypi and patches of granulations can be removed under cocain anesthesia. A rubber obturator plate is then to be fitted by a dentist. The patient irrigates several times daily, and the cavity is inspected from time to time in order to treat surgically any hypertrophy of the mucous membrane or patches of granulation. The healing always requires a number of months. A large opening will persist without harm for a long period or indefinitely.

When inspection shows extensive changes in the cavity at the time of the operation, or when such changes can be assumed on account of rebelliousness to previous treatment through a former opening, a more radical operation is to be performed. The entire anterior bony wall is then to be resected, and, after thorough curetting of the interior, the anterior flap of periosteum and mucous membrane is pushed into the cavity after loosening it by two lateral vertical incisions. It is then made to cover the denuded walls by tamponing. In extreme instances Boenninghaus has added to this operation the removal of the nasal wall of the sinus by careful chiseling from the

side of the antrum. He thereupon pushes the mucous membrane into the sinus from the nose, and thus practically covers what is left of the sinus walls with healthy mucous lining from the nose and from the gum. As cicatrization proceeds very slowly over the denuded sinus walls, the transplantation of Thiersch grafts has been practised to advantage. The healing requires many months, but ultimately an entire cessation of secretion can be obtained.

A similar but less radical operation has been practised by Caldwell and is warmly indorsed by Luc. The anterior bony wall is lifted up in the form of a flap with base up by chiseling and finally breaking the bone. The cavity is inspected and treated, and a counteropening is made into the nose. The diseased lining of the sinus is thoroughly destroyed by swabbing with a saturated chlorid of zinc solution. After a gauze drain has been placed through the nasal opening, the anterior flap is replaced and sutured.

## CYSTS IN THE MAXILLARY SINUS.

**53.** Autopsies and surgical explorations have shown the frequent occurrence of cysts in the maxillary sinus, sometimes with very little concomitant disease of the mucous membrane. They are either retention cysts, originating from the mucous glands, or edematous accumulations in the interior of polypoid hypertrophies. The contents are usually a clear, yellowish, viscid fluid which coagulates spontaneously. Glandular cysts may also have purulent contents due to secondary infection. The symptoms due to cysts are vague. Probably no annoyance is caused in many instances. In others they may induce nasal irritability. Local discomfort, headaches, and ill-defined neuralgic pains are sometimes produced by them, and are relieved by treatment. If not accompanied by empyema or not purulent in themselves, these cysts cannot be recognized with certainty. Translumination usually shows a suspicious reduction of translucency, but

not always. On puncturing and aspirating, the characteristic clotting fluid is obtained. If cholesterin crystals are found, it indicates a retention cyst. Evacuation relieves the symptoms, sometimes permanently, sometimes transiently. When the contents are purulent, a rapid but only apparent cure results from a single irrigation, but a permanent result can be obtained only by evulsion of the cyst-wall through a sufficiently large opening.

Of an entirely different nature are dental or follicular cysts. They are made up of a thin bony capsule, often containing an included tooth. The fluid is turbid and viscid or even purulent. They are of slow growth, but ultimately lead to distention of the antrum and bulging of one or more of its walls. Follicular dental cysts and tumors are the only lesions which are positively known to cause distention of the antrum walls. The other symptoms are usually vague. The treatment consists in removal of the entire capsule with chisel and bone forceps through an opening in the canine fossa.

## CHAPTER VIII.

### DISEASES OF THE FRONTAL SINUS, ETHMOID CELLS, AND SPHENOID SINUS.

#### INFLAMMATION OF THE FRONTAL SINUS.

**54. Acute inflammation of the frontal sinus,** less common than acute disease of the maxillary cavity, is a well-defined clinical occurrence. During a coryza or after an influenza or some general systemic infectious disease (typhoid fever or erysipelas) it starts with slight fever and pain over the brow, the latter sometimes very severe. There may be more or less continuous dull browache, with spells of sharp, supra-orbital neuralgia. Often there is transient edema of the upper eyelid. There is always tenderness to touch over the brow and on the upper wall of the orbit. The disease is mostly one-sided. Either at once or within a few days there occurs a profuse purulent discharge from that side of the nose, sometimes with relief of the pain. Of course, there is some nasal stuffiness, especially if there is a complicating diffuse nasal catarrh. Acute frontal sinuitis heals in most instances within from two to three weeks, but without adequate treatment an unknown proportion of cases become chronic. Even after apparent cure, occasional later relapses are not uncommon. The diagnosis, complications, and treatment can be discussed under one heading for acute and chronic disease.

**55. Chronic inflammation of the frontal sinus** is usually the prolongation of an acute attack. In other instances it begins insidiously. Its occurrence is favored by septum deflection and hypertrophies in the middle nasal meatus, the latter themselves often a result of sinuitis. The disease is sometimes wholly latent, and indicated only

by purulent discharge. Usually subjective symptoms are added whenever an acute coryza occurs. In most instances more or less suffering is constantly present. This may be dull or sharp frontal headache, usually but not invariably one-sided, when the sinuitis is one-sided, which is the more common occurrence. More characteristic is supra-orbital pain in attacks, sometimes of remarkably punctual periodicity. Mental irritability, depression, inability to concentrate the attention, more rarely dizziness, may be complained of. There is commonly tenderness over the brow and along the upper wall of the orbit. Occasionally puffiness of the upper eyelid is seen.

The discharge is variable in amount, and is sometimes retained for a few days on account of swelling in the infundibulum. When temporarily confined, it may or may not cause suffering, which may be suddenly relieved by the reappearance of the flow. When profuse, the flow is fairly continuous during the erect posture. The pus is not always fetid, rather less often than in the case of maxillary empyema. The mucous membrane around the infundibulum underneath the middle turbinal is mostly swollen. During acute sinuitis this swelling is due to edema. Later on polypoid hypertrophy of the edges of the hiatus semilunaris is common. When there is much discharge, chronic rhinopharyngitis usually results. The effects of pus-formation and swallowing of pus upon digestion and nutrition are sometimes seen when the suppuration is profuse.

**56.** Distention of the walls of the sinus, especially bulging of the thin roof of the orbit, is an occasional symptom. This may occur very slowly, but sometimes increases rather suddenly. The contents in this case are either a viscid, slightly turbid mucus, or a mucopurulent fluid, but usually not pure pus. In some instances they have been found bacteriologically sterile. While it has been usually assumed that the accumulation of contents and the resulting distention depended on occlusion of the frontal duct, it has been shown recently (Avellis) that at

least in some of these cases the lesion is not at all primary disease of the frontal sinus, but a closed mucocele or empyema of an ethmoid cell intruded into the frontal sinus. After a slow growth for a long time, such a mucocele may finally perforate into the orbit.

The severest cases are those in which caries of the bony walls leads to perforation. This happens rarely in the first acute attack, more commonly during a later acute exacerbation. The least serious, but also the least frequent, perforation is through the anterior wall, causing an external fistula. More common and more important is the breaking-down of the orbital wall. The escape of pus into the orbit may lead to diffuse phlegmonous inflammation and may even cause extension into the cranial cavity, with fatal results. In more fortunate cases a circumscribed orbital abscess results, which may open at the upper inner angle of the orbit. A most serious but relatively rare accident is caries of the posterior wall of the sinus, resulting in intracranial disease in the form of a subdural or cerebral abscess or a diffuse meningitis or thrombosis of the longitudinal sinus. Further diagnostic references regarding pyogenic intracranial affections can be found in the chapter on Intracranial Complications of Middle-Ear Disease.

Frontal sinuitis causes ocular disturbances quite frequently. Asthenopic discomfort from the use of the eyes and insufficiency of convergence are frequent functional disturbances. Constriction of the visual field has been observed. When distention of the orbital wall occurs, the eyeball is displaced laterally and its mobility may be interfered with. The most serious consequences may ensue in case of perforation into the orbit. Thrombosis of the retinal vein, optic neuritis, and, later on, atrophy have been observed, although such complications are rare.

**57.** The lesions in the frontal sinus are principally inflammatory edema during the acute stage. The chronic form depends mostly on hypertrophy of the mucous

membrane. In more serious cases the bony walls become involved, at first by the formation of osteophytes, but in severe infections later on by caries. Perforation seems to occur especially along the channels of exit of the sinus veins, which become thrombosed. When the walls are gradually distended, the process is one of bony absorption on the inner side, with deposition of fresh bony lamellæ under the external periosteum. The passage-way from the frontal sinus to the infundibulum is probably never or rarely closed permanently, but sometimes temporarily occluded at its nasal end by swelling or hypertrophy of the mucous membrane. In many instances inflammation of the frontal sinus is complicated by suppuration of one or more of the most anterior of the ethmoid cells, which may communicate with the frontal sinus or intrude into it.

The **diagnosis** of frontal sinuitis is suggested by the external signs, when present—viz., supra-orbital neuralgia, tenderness, especially along the inner upper wall of the orbit, edema of the lid or bulging of the sinus wall. Pain and tenderness without other symptoms are not sufficient to establish the diagnosis. They may be due to true supra-orbital neuralgia or to hysteria with some form of asthenopia. Mucocele without discharge can be recognized only when bulging occurs. The discharge of frontal sinuitis is found issuing underneath the middle turbinal. It may be difficult to distinguish between inflammation of the frontal sinus, the ethmoid cells, and maxillary antrum by means of the nasal symptoms. Maxillary disease must first be excluded by transluminination or exploratory puncture. An effort should be made to pass a probe through the frontal opening. A flexible silver probe is bent at an obtuse angle about 3 cm. from its end, and the intranasal part may be slightly curved, with convexity toward the external side. After cocainization the probe is to search underneath the front end of the middle turbinal until it finds a passage leading upward and forward. When it has been pushed in by gentle manipulation to the extent of 3 cm., it is either in

the frontal sinus or in an anterior ethmoid cell intruded into the sinus, which cannot be distinguished from the sinus. Probing is successful only in a minority of cases. When the removal of the probe is followed by a flow of pus, a diagnosis is established. In doubtful cases syringing in the direction of the probe by means of a thin cannula may bring forth the pus. These manipulations are much easier after the front end of the middle turbinal has been snared off. Repeated examinations may be necessary to make a diagnosis. It is sometimes possible to force out the pus by air pressure according to the Politzer method of inflation—viz., by blowing into the nose with a rubber bag during the act of swallowing, while the other nostril is firmly closed with the finger. Translumination has been practised by means of two small hooded lamps pressed against the upper inner recess of the two orbits. In the absolutely dark room or under a hood a red glow is seen over the area of the normal frontal sinus. As this is not necessarily symmetric on both sides, translumination has not been found trustworthy by most observers.

**58.** The **treatment** of acute disease requires rest and reduction of the swelling of the nasal mucous membrane. Cocain, suprarenal solution, the douche (in case of diffuse nasal suppuration), or sprays favor drainage from the frontal sinus. The neuralgia can be checked by antipyrin or quinin in acute, but rarely permanently in chronic, cases. Pain of any kind is relieved by drainage of the pus. This may be attempted by irrigation through the natural orifice if feasible. Decided relief can sometimes be obtained by forcible inflation of air by the Politzer method. When, in chronic cases, hypertrophies are found underneath the middle turbinal, it is best to snare off the front end of that bony process. Polypoid growths may be removed by the snare or sometimes even better by means of a curet. The burner should never be used in this locality for fear of obliterating any of the orifices of the different sinuses. If irrigation of the

sinus is possible, its efficacy may be increased by using solutions of silver nitrate, 2 to 5 per cent. in strength, after the pus has changed into a mucous secretion. So long as the fluid is thick and yellow, there seems to be no advantage in using anything but salt or boric acid solution. Intranasal methods of treatment usually suffice, even when there is some distention of the sinus walls. A number of weeks or even some months may be required, however. When the persistence of thick and yellow pus indicates graver changes in the mucous membrane or the bony walls of the sinus, or when alarming symptoms in the form of uncontrollable pain or cerebral irritation suggest the possibility of perforation, an external operation becomes necessary.

As a substitute for an external opening Schaeffer and others have penetrated into the frontal sinus from the nose by boring upward with a scoop, either between the middle turbinal and roof of the nose, or along the natural channel from the sinus to the infundibulum. These attempts have been justly abandoned by most surgeons, as they involve the risk of penetrating into the cranial cavity.

59. Of all **external surgical procedures,** Kuhnt's operation has received the most extensive trial and has given satisfactory results. An incision is made down to the bone in the hairy part of the brow, through two-thirds of its length, beginning at the nasal end. The brow hides the resulting scar, and as the hairs can be satisfactorily sterilized, it is best not to shave them off. A vertical incision about 3 cm. long is then extended upward in the crease made by the corrugator muscle. The periosteum is detached from the bone, which sometimes is difficult to do, and a triangular flap is lifted upward and outward. The front wall of the sinus is entered either by a trephine run by a motor or by means of a chisel, and if the sinus is found filled with granulations, the entire anterior wall is resected. The entire mucous membrane is removed by curetting, with pains to enter every recess, including the sinus end of the

frontal duct. The duct is thoroughly cleared or enlarged down to the nose, and the wound is thereupon sutured, leaving only a small gap for a gauze drain at the median end. The posterior wall is closely inspected and probed if there is any suspicion of extension to the cranial cavity. In case a cerebral abscess is suspected, it can be sought and opened after cautious resection of the posterior sinus wall. Under daily irrigations through the wound a cure is usually attained inside of six weeks. The sinus becomes obliterated, and the skin-flap sinks in, but the resulting disfigurement is not very conspicuous. The only objection against the operation is that in case of multiple disease of the frontal sinus and the ethmoid cells the latter cannot be easily reached through the wound.

It is needless to specify all the various modifications of this operation which have been devised, but not extensively tried. Jansen resects the inferior (orbital) wall of the sinus and thereby gains easier access to the ethmoid cells if required. His results are good, but are attended with considerable disfigurement. An osteoplastic operation with the immediate replacement of the bony flap has been practised by Czerny, Killian, and others. Goluvin has performed the same operation with a device to prevent disfigurement. His incision is like that of Kuhnt. Upon raising the skin-flap, without periosteum, he chisels a flap through bone and periosteum, with convexity upward, and hinges it forward by breaking it at its inferior base. The sinus is then curetted, thorough connection established with the nose, the bony flap replaced, and the skin sutured completely. The subsequent treatment is entirely carried out through the nose. The same author has also reported a series of cases in which good, quick, and permanent results were obtained by making merely a small trephine opening and destroying the diseased lining of the sinus by means of steam. The steam is conducted from a small boiler through rubber tubing and a rubber cannula into the opening made

by the trephine, and allowed to act for from one-quarter to one-half of a minute. The result is obliteration of the sinus by ossification. The wound should be kept open and drained until dry.

### SUPPURATION OF THE ETHMOID CELLS.

**60.** The ethmoid cells have not received as much attention at autopsies as the other accessory cavities, and hence we possess less accurate information regarding the frequency of their involvement in disease. Clinically, ethmoid suppuration is nearly, if not quite, as frequent as disease of the maxillary sinus, but it is probably not recognized as often. It takes its start from an ordinary coryza, an influenza-rhinitis, or more insidiously from some systemic infection. Very little is known clinically about the acute stage of ethmoiditis. It is ordinarily observed in its chronic form. There may not be any but nasal symptoms. A number of patients, however, complain of more or less severe, though not characteristic, headaches, without definite localization; sometimes of periodic attacks of migrain. There is sometimes tenderness to pressure over the bridge of the nose. Mental irritability, depression, less commonly vertigo, may or may not be present. Long-continued suppuration may itself be the starting-point of severe neurasthenia. The intensity of suffering depends somewhat on the neuropathic disposition of the patient. Intolerance to alcohol has been often observed.

But in other patients there may be none but nasal symptoms, and possibly these even of moderate degree. Except in very wide passages there is always more or less obstruction. This is partly due to transient venous turgescence. In many instances, however, the obstruction depends upon the presence of polypi. Of all the various forms of sinus disease, none are more frequently productive of polypi than suppuration of the ethmoid cells. But this coincidence is not invariable, and, on the other hand, polypi may occur without ethmoid suppura-

tion. Yet the presence of polypi with purulent discharge should always raise a strong suspicion of ethmoid disease. The disease is perhaps as often bilateral as one-sided.

In a certain number of instances ethmoid suppuration is either accompanied by **ozena** or produces the entire train of symptoms which we term ozena. The discharge may dry in the form of adherent crusts of characteristic foul odor, with the appearance of atrophy of the inferior turbinal. It is at present impossible to state definitely the relationship between ozena and suppuration of the ethmoid or other accessory cavities. There is every reason to believe that ozena can exist as a diffuse disease of the nasal lining, without involvement of any of the sinuses. Sinus disease, however, is at least a frequent complication of ozena, and, on the other hand, there are some instances in which the entire clinical picture of ozena ceases after the cure of a suppurating sinus or ethmoid cell.

**61.** Apart from the cases presenting the appearance of ozena, the discharge is a creamy pus or purulent mucus, sometimes bland, sometimes fetid in odor. Its apparent origin varies according to whether the anterior or the posterior ethmoid cells are diseased. In involvement of the anterior ethmoid cells the pus issues underneath the middle turbinal near its front end. As a rule, it flows toward the anterior nares, but occasionally through the middle meatus to the posterior choanæ, thence dropping into the throat. Its path can then be seen in the post-rhinoscopic mirror. Suppuration of the anterior ethmoid cells can be assumed whenever pus in any quantity flows into the middle meatus, and disease of the maxillary and frontal sinuses can be excluded. In multiple empyema, in which the ethmoid cells participate as well as one or the other of the other accessory cavities, or both, the diagnosis of ethmoiditis can be made gradually only after emptying the other sinuses, and still finding pus issuing forth. It is sometimes necessary to tampon the middle meatus with bits of cotton temporarily in order to demonstrate the source of the pus. Probing of the

anterior ethmoid cells is very uncertain and not definitely indicative of their disease. The probe can be passed into one or more orifices upward and slightly outward underneath the middle turbinal. If pus can be removed by irrigation through a slender cannula introduced into these spaces, the diagnosis is more definite. These measures are all facilitated by the removal of the front end of the middle turbinal.

The secretion from the posterior ethmoid cells issues through orifices above the middle turbinal into the superior meatus of the nose. When the olfactory fissure is seen filled with pus, this fluid comes either from the posterior ethmoid cells or from the sphenoid sinus. The distinction is neither easy nor always possible. The diagnosis is largely based upon exclusion of sphenoid disease, according to the methods given in ¶ 66.

The recognition of disease of the posterior ethmoid cells may be more definite after space has been gained by removal of the middle turbinal. This can usually be done only gradually by snaring off the front end and subsequently the rear end, and finishing with cutting forceps. The pus from the posterior ethmoid cells is as likely to flow into the pharynx as into the anterior nares. Not rarely it forms adherent crusts at the roof of the pharynx.

Besides empyema of the ethmoid cells with escape of pus into the nose, we must recognize a form of ethmoiditis with confined secretion (mucocele). The fluid is more likely to be mucous or mucopurulent than pure pus in these cases. Its accumulation causes distention of the cell in which it is found. This may be a cell intruded into the front end of the middle turbinal, or it may be the ethmoid bulla underneath the middle turbinal, which, when enlarged, appears as a reduplication of the turbinated process. Confined secretion reveals itself in these instances by nasal irritation, stuffiness, or headaches. On inspection a distended, bony tumor is seen protruding into the nose. Confinement of secretion

with distention may also occur in the cells adjoining the lamina papyracea. In that case a bulging appears at the inner wall of the orbit. Perforation may take place into the orbit with results similar to those caused by perforation of the frontal sinus. Encroachment upon the orbital space starts from ethmoid cells oftener than from the frontal sinus, and the site of the tumefaction is below the inferior wall of the frontal sinus. Pressure upon such orbital tumefaction gives to the finger the same sensation of yielding as when the thin cover of a tin can is pressed upon.

**62.** Apart from the orbital symptoms produced by the bulging of the lamina papyracea or its perforation, ethmoid disease may lead to various ocular disturbances. Asthenopia is not uncommon. Recurrent iritis is sometimes observed. The writer has seen repeatedly a peripheral palsy of ocular muscles, the coincidence of which with an exacerbation of one-sided ethmoid disease was a strong reason for suspecting the latter as the etiologic starting-point. There are on record a moderate number of well-authenticated instances of fatal meningitis resulting from suppuration of the ethmoid cells. Ethmoid empyema, like other forms of nasal suppuration, is likely to induce secondary hypertrophic changes in the nose and pharynx, with occasional extension into the larynx or even further down.

**63.** The lesion in suppuration of the ethmoid cells is at first inflammation of the mucous membrane. It is characteristic of the lining of these spaces that it swells readily in response to irritation. Acute inflammation may cause edema, which makes the mucous membrane protrude wherever it is not confined. After amputation of the front end of the turbinal the lining membrane underneath will often appear swollen and polypoid shortly after exposure. This acute condition may subside completely. But in the course of more persistent inflammation, hypertrophy of a permanent character takes place. Hence ethmoid suppuration is often accompanied by hypertro-

phies of the mucous membrane and true polypi. In the course of time the thin bony lamellæ become involved, as the mucous membrane and periosteum are practically continuous. The bony lesions are partly those of a rarefying ostitis with partial absorption, partly thickening of the bony plates secondary to proliferative periostitis. In rare cases the disease may be limited to but one or a few cells. More commonly suppuration extends through an entire series of ethmoid cells, anterior or posterior, or sometimes both.

Woakes, who first drew attention to the frequency of ethmoid suppuration, vitiated his clinical observations by false pathologic notions. He described, as the basis of the disease, necrosis of the bone, "necrosing ethmoiditis." His theory, accepted to some extent by clinicists, has been entirely refuted by anatomic research. Necrosis and caries of the bony walls play a very small rôle in ordinary forms of suppuration of the ethmoid cells. Destruction of bone may be a secondary complication in very severe disease. But, on the whole, it is not common, except as the result of syphilis, or, less frequently, tuberculosis.

**64.** The **treatment** of ethmoid disease requires, in the first place, the removal of all polypi and hypertrophies of the nasal lining. If these are difficult of access, it is best to snare off the middle turbinal at its front or even at its rear end. Under the use of the douche, or, still better, irrigation through a slender cannula brought close to the ethmoid orifices, a small number of cases will heal in the course of weeks. The larger proportion are only benefited, but not cured, by this treatment. A more radical measure is the exposure of the suppurating cells, usually after resection of the middle turbinal. The safest and most satisfactory instrument is the sharp nasal hook, suggested by Hajek (Fig. 49). This is not likely to do accidental damage, which must be feared when drills are employed. The hook follows the path previously explored by the probe when searching for the origin of the pus. The suspected orifices under the insertion of the middle turbinal are entered and torn open. As a rule,

the slender hook suffices; if necessary, the heavier model is employed. Each suspected cell is torn open, and the shreds of the mucous membrane and bone are clipped off with cutting forceps. There is generally enough bleeding to necessitate the gradual performance of the operation at successive times. In searching for the posterior cells, the hook passes into the olfactory fissure above the middle turbinal. As long as the nasal roof is avoided there is no risk in these manipulations. As soon as a suppurating cell is thus completely exposed and drained, the symptoms caused by it, especially the headache, cease promptly. As long, however, as symptoms continue, the surgeon must try to follow the channels of suppuration by opening other cells or breaking down the

FIG. 49.—Hajek's hooks. They fit into the usual nasal handle at an obtuse angle.

thin partitions between them by means of curets. The treatment, therefore, is very apt to be tedious, but it is sure to give relief. Still only a small proportion of patients are completely cured. In the majority the distressing symptoms are relieved, but the secretion is not entirely stopped.

The treatment is simple and quite efficacious in case of secretion pent up in one or a few ethmoid cells—the so-called ethmoid mucocele. It suffices to expose these cells thoroughly by removal of the bony wall. According to the location and prominence of the distended cell, this can be done either with a snare or the hook, or a hand-drill, and finished with a curet or cutting forceps.

In exceptional cases of alarming severity, and espe-

cially in instances of multiple empyema, it may prove necessary to perform an operation from the outside, with complete exposure of all the ethmoid cells. This operation will be referred to under the head of Multiple Empyema.

### INFLAMMATION OF THE SPHENOID SINUS.

**65.** The sphenoid cavity is frequently found diseased in autopsies. But clinically affections of this space are not observed so commonly, probably because they are often overlooked. The symptoms are not definite. We do not know how many cases run a latent course, the disease causing merely nasal suppuration and obstruction. The pus is observed in the olfactory fissure, between middle turbinal and septum, more often one-sided than bilateral. It is as likely to flow through the posterior choanæ as into the anterior nares. In some instances sphenoid suppuration produces the symptoms of ozena—viz., fetid, adherent crusts, with tendency to atrophy of the inferior turbinal. Probably many of the instances of crust formation at the roof of the pharynx are due really to sphenoid suppuration. The nasal obstruction which may result from sphenoid affections is due mainly to turgescence of the rear ends of the turbinal. In fact, every periodic engorgement of the cavernous tissue at the level of the posterior choanæ should direct suspicion toward the sphenoid sinus.

When headache is present, it is generally of a severe type and not definitely localized. It seems to be a fairly frequent symptom. The disease starts sometimes in an acute manner—for instance, after influenza. In other cases its origin cannot be traced. Eye symptoms in the form of asthenopia are not uncommon. Extension of the disease through the upper wall has in some instances caused optic neuritis, in others atrophy of the optic nerves. Caries of the sphenoid walls, though probably not common, has been observed. It has caused fatal hemorrhage by erosion of the carotid artery. Thrombosis of

the cavernous sinus is likewise a possible consequence, as well as fatal meningitis.

**66.** The **diagnosis** depends upon exploration of the sphenoid sinus through its orifice. If the probe slants sufficiently backward and upward, it is bound to touch the anterior surface of the sphenoid body. By holding it nearly vertical and probing too near the front end of the middle turbinal its tip reaches the dangerous nasal roof. But by crossing the middle turbinal behind its center this danger is avoided. The sphenoid orifice is situated close to the roof of the nose and nearer to the lateral wall than to the septum. By bending the tip of the probe a trifle upward, it is quite often possible to enter the sphenoid orifice. The distance from the inferior rim of the pyriform aperture to the sphenoid opening varies from 6 to 8 cm. in the adult. After entering the orifice the probe can then slip into the sinus to the extent of 1 to $2\frac{1}{2}$ cm. When pus issues next to the probe or adheres to the probe, the diagnosis is established. If this test fails, a slender cannula can be substituted for the probe, and an attempt made to dislodge the sphenoid secretion by warm salt solution. It is often difficult, sometimes impossible, to distinguish between suppuration of the posterior ethmoid cells and of the sphenoid sinus until the middle turbinal has been nearly entirely removed.

**67. Treatment.**—When the inflammatory process in the sphenoid is of a superficial character, a few irrigations through the natural orifice will sometimes terminate the disease. In instances attended with suffering, the first successful irrigation gives relief. If irrigation through the natural opening proves impossible or insufficient, the anterior wall of the sinus can be opened in the safest manner by means of Hajek's hook. Traction with a hook does not involve the risk of slipping that attends the use of a drill or a perforating curet. The opening of the sinus suffices for a gradual cure, except when its interior lining is permanently hypertrophied. In such instances the mucous membrane has been successfully removed by means of

the curet or the introduction of a pledget of cotton on a probe moistened with chlorid of zinc solution. This should be introduced through a tube in order to protect the nasal lining. On account of the possible thinness of the upper wall of the sinus, Hajek advises as the safer method the evulsion of the thickened mucous membrane with forceps rather than with a curet working in the confined space. The use of the curet on the inferior wall involves no risk. In the majority of instances, suppuration of the sphenoid sinus can be controlled by treatment with more certainty than extensive disease of the ethmoid cells.

## MULTIPLE EMPYEMA OF SEVERAL ACCESSORY CAVITIES.

**68.** Although sinuitis is mostly limited to one cavity, multiple disease of several spaces is not uncommon. Such instances may be one-sided or bilateral, in the latter cases perhaps most frequently with symmetric involvement on both sides. In the case of the frontal sinus bilateral disease is sometimes due to a defect or morbid perforation of the median partition wall. The spaces which participate the oftenest in multiple empyema are the ethmoid cells, the anterior in connection with maxillary or frontal sinus disease, the posterior with sphenoid suppuration. Occasionally all cavities are found diseased on one or even both sides.

As in the case of disease of a single sinus, the symptoms may vary greatly. On the one hand, a few patients complain of nothing but a very profuse discharge. It is remarkable how little disturbance of health there may be in such exceptional cases. On the other hand, there may be, besides the local discomfort and the nasal secondary disturbances, headaches of great severity, general malnutrition, and neurasthenia, until the patient becomes a physical wreck.

The diagnosis can be made only gradually, as the involvement of one cavity after another is being recognized.

Efforts must be made to trace the origin of the pus according to the indications discussed previously.

**69.** In instances in which no severe or dangerous symptoms are present, the attempt may be made to expose the suppurating spaces by the same intranasal operations which apply in disease of each individual sinus. But whenever urgency is called for, a more radical method is the free opening of the accessory spaces from the outside. A number of different modifications of osteoplastic operations have been devised by Gussenbauer, Winkler, and Killian. All of them give fairly satisfactory results; none of them have received extensive trial. The principle of such an operation for one side at a time is the following:

General narcosis, tamponing of the nasopharynx, incision down to the bone in the median line from the upper level of the frontal sinus along the bridge of the nose down to beyond the lower border of the nasal bone, pushing back the periosteum sufficiently for separation of the nasal bones at the nasofrontal suture. Subperiosteal resection at the same level through frontal process of superior maxilla with a fine saw or chisel, opening the bony frame of the external nose through the suture between the two nasal bones, and pushing outward the external wall of the nose (nasal bone and frontal process of submaxilla), if necessary after grooving along its nasal surface in case it offers too much resistance. The ethmoid cells can now be entered from the front, and by breaking down all cross partitions and septa with forceps, they can be changed into a single continuous space from lamina papyracea to middle turbinal, opening freely into the nose. The operation can be extended to the anterior sphenoid wall, and the sphenoid sinus exposed. In case of frontal empyema a horizontal incision is extended through the brow, a portion of the anterior wall of the sinus is resected, the duct identified by a probe introduced into it, and the floor of the sinus chiseled away as far as it is accessible from the nose. Gauze tam-

pons leading into the nose, replacing of bone flaps, primary or early secondary suture. After-treatment through the nose.

In Gussenbauer's operation for bilateral disease the cutaneous incision begins near the middle of each eyebrow, runs down vertically (about 5 mm. beyond the internal canthus) along the sides of the nose, and connects across the nose at the lower border of the nasal bones. A single bony flap is made of all the nasal walls circumscribed by the incision, including the lachrymal bone and a slice of the lamina papyracea, as well as the perpendicular plate of the ethmoid. After sawing and chiseling through all connections, the flap is reflected upward and access obtained to the upper part of the interior of the nose and the entire ethmoid labyrinth on both sides. After the complete exenteration of all diseased spaces the flap is replaced.

## CHAPTER IX.

### OZENA (FETID ATROPHIC RHINITIS).—SIMPLE ATROPHIC RHINITIS.

**70. Symptoms and Course.**—Atrophic rhinitis is characterized by a purulent secretion, drying in the form of adherent crusts, and accompanied by progressive atrophy of the nasal mucous lining and of the turbinated bones. In the "simple" form the crusts are nearly odorless; in the fetid form—the more common variety—the crusts have a very strong offensive and characteristic smell. As the fetid form can be changed by treatment into the odorless simple form, the two varieties of the disease—similar in course—may be considered under one head.

The beginning of the disease has been but little described and is probably not seen often. In some personal observations it began as a minimal localized focus of characteristic suppuration on the middle turbinal, with crust-formation gradually extending in area. The subjective annoyance is but moderate. There is some transient obstruction when large scabs form, which diminishes, however, as the atrophy proceeds. The crusts cause the patient to blow forcibly in order to expel them, as there is but little fluid discharge. In neurotic subjects severe headaches, both more or less irregularly continuous pain, as well as periodic attacks of migrain, are not uncommon. The patients have occasional fresh "colds," with increased discharge, but these attacks are both less severe and less common in atrophic rhinitis than in other chronic forms of nasal disease. They cease almost entirely when the atrophy has advanced far. The most distressing symptom, present only in the fetid form, is the foul odor noticeable sometimes across the room, but not perceptible to the patient. The patient's sense

of smell is often reduced, especially when there is abundant scab-formation.

The discharge is viscid greenish-yellow, and so tenacious that it does not flow along the mucous surface, but adheres and dries superficially, forming scabs with some thick fluid underneath. It is formed mainly around and opposite the middle turbinal, but is, of course, gradually pushed down by further flow from above. A large part of the nasal walls may thus be lined with crusts. The amount of crust-formation varies. In many cases casts are found at the roof of the pharynx. Occasionally the disease seems to be limited to this locality alone. When the disease improves under treatment, the pus becomes more fluid, less greenish, and changes finally into a slightly purulent mucus. The odor in the fetid variety is so characteristic that an experienced diagnostician can distinguish it at once from the smell of either syphilitic necrosis or of suppurative sinuitis with retention. But the odor is not inherent in the fresh discharge: it is the result of secondary changes. When the crusts have been thoroughly removed and are not allowed to form again by proper tamponage of the nose, the pus upon the tampon has merely a slightly mawkish odor, as in the simple, non-fetid variety. The fetid form can thus be transformed into the non-fetid variety, but usually changes back in the course of weeks when the treatment ceases. Whether the non-fetid form occurring spontaneously acquires the odor in the course of time is not known. But while the odor is thus a secondary feature, it is one of great importance, for not only is it the main annoyance to the patient, but the changes which cause the odor are, by themselves, a significant factor in the course of the disease. The simple non-fetid atrophic rhinitis—much less common than the typical form of ozena—shows neither as much discharge nor as much atrophy as is usually found in advanced cases of fetid ozena.

**71.** The atrophy of this disease is a gradually increasing process. Scarcely recognizable at first, it continues until

the passages have become abnormally wide and the complex architecture of the turbinals is reduced to rudimentary ledges. When ozena occurs in a nose with strongly deflected septum, the atrophic process is always much less pronounced on the side narrowed by the convexity of the septum. In extreme cases of this kind the disease seems to be almost wholly one-sided, while ordinarily it is symmetric. The atrophy involves the entire mucous membrane. The venous plexus shrinks likewise, and turgescence becomes finally impossible. Even in the living it is evident that the atrophy involves also the bony structure of the turbinals and leads to their reduction in size and partial absorption. Ulceration and caries of bone are, however, never found in ozena. Occasionally a circumscribed hypertrophy of the mucous membrane over a part of a turbinal—probably antedating the ozena—persists for a while. Hypertrophy of the pharyngeal tonsil is conspicuously absent. Moderate enlargement of the faucial tonsil is sometimes met with.

Ozena begins mostly in childhood after about the sixth to the eighth year, less commonly in adolescence. The fetid variety is much more common than the disease without odor. The female sex preponderates markedly. The disease continues an indefinite period, but probably ceases in some instances spontaneously in middle or advanced life. The atrophy, however, remains.

Ozena does not often lead to complications. Ulcerative blepharitis of a severe type, purulent dacryocystitis, less frequently persistent secretory catarrh of the middle ear, are its possible consequences.

**72. Pathology.**—Atrophic rhinitis is an inflammatory disease. As long as the atrophy is not complete, the mucous membrane is found infiltrated with round cells, both in a continual subepithelial layer, as well as around arterioles and glands. The cylindric ciliated epithelium is changed into non-ciliated cuboid pavement cells. The surface epithelium, as well as the gland-cells, shows fatty infiltration. From the start the atrophic changes are

unmistakable. The mucous membrane becomes gradually thinner, the glands shrink and finally disappear largely, while arteries, and still more the venous plexus, atrophy proportionately. The bony skeleton of the turbinals shrinks in all directions and becomes fragile, showing a histologic picture of bone absorption (osteoclasts). The atrophic process is a diffuse one, although not always uniformly extensive.

It has been shown clinically by Grünwald, and confirmed by Hajek and others, that ozena is often *associated* with *suppurative inflammation* of one or more *accessory cavities*, especially the sphenoid sinus. The extreme view, however, which considers ozena simply and invariably a manifestation of sinus disease, is not tenable. A number of autopsies have shown that ozena can exist without involvement of any sinus. Clinically, too, cases are occasionally observed in which the curative influence of douches and tampons permits us to exclude sinus disease, which would not yield to these measures alone. On the other hand, the majority of unquestionable instances of suppuration of the various sinuses do not present the characteristic clinical picture of ozena—viz., the typical greenish adherent crusts and the progressive atrophy. The odor of foul pus from a sinus is also not identical with that of ozena—at least, as a rule.

There can be no doubt, however, that suppuration of one or more sinuses is an important and frequent, though probably a secondary, lesion in ozena, and that this association explains in many instances the inefficiency of treatment. It may even be stated that there are occasional instances of apparently typical ozena, usually not far advanced, in which the cure of suppuration from the sphenoid sinus or the ethmoid cells puts an end to all manifestations of ozena. The atrophy, however, remains, but this has generally not advanced far in cases of this description.

**73.** As the cause of atrophic rhinitis, a microbe has been described by Löwenberg in the shape of a coccus.

But the same germ was subsequently identified by Abel (Paulsen and others) as a short bacillus—the bacillus mucosus capsulatus.[1] It has been invariably found, although in scant number, in the fresh discharge in this disease, whether odor was present or not. This microbe does not give rise to the characteristic odor in cultures. It has been seen occasionally in the discharge in other nasal diseases. This latter fact would not overthrow its etiologic significance, as it is well known that different unquestionably virulent microbes (diphtheria, cholera, and tubercle bacilli) can occur at times on mucous surfaces without leading to infection. But since this bacillus is not found in the interior of the tissues, and since no conclusive inoculations have been reported, its importance cannot be said to have been fully established. Still, infection by some specific form of microbe is the most plausible explanation of the peculiarities of this disease. Coexisting inflammation of different sinuses may, however, be a secondary or mixed infection with other pyogenic micro-organisms. The secretion started by this specific infection differs, at least quantitatively, in its composition from the pus of other diseases, for in other nasal affections we do not find such crusts unless there is ulceration present, as in syphilis and infected wounds, and in these cases the crusts have not the characteristic odor. Yet the odor is not directly due to the presumable parasite of ozena, since, as stated before, the smell can be abolished by preventing retention and drying of the discharge, while in the simple form of atrophic rhinitis there is no odor at all. Hence it is probable that

[1] A bacillus about 1.25 $\mu$ thick, of variable length—sometimes so short as to look like a coccus. Often in chains. Surrounded by a distinct capsule. The bacillus is easily stained, but loses its color by the Gram method. Aërobic. Grows on gelatin, forming thick white colonies of fluid but viscid consistency, without diffuse liquefaction of soil. On potato a creamy rich growth of color of soil. Retains its life in culture indefinitely. Pathogenic to white mice, producing a local exudate and septicemia. Much less virulent to other animals. While this bacillus belongs to the same group as the pneumobacillus of Friedländer, it is distinguishable from it by its cultural peculiarities.

the characteristic smell is produced by secondary decomposition of the pus by other bacteria, which find a favorable soil in the pus peculiar to the "fetid" form of this disease, but which in certain other cases—the simple form—are resisted by (unknown) influences unfavorable to them. These secondary decompositions undoubtedly are an additional pathogenic factor in the disease, since any tendency toward improvement is observed only when the retention and decomposition of the discharge are prevented artificially. Besides the bacillus mucosus capsulatus, other bacteria are always in abundance in the crusts. There is no clinical evidence that ozena is contagious. Its rare occurrence in several members of one family is more likely due to congenital anatomic predisposition.

It is noticeable that atrophic rhinitis occurs usually in relatively spacious nasal passages. Measurements by Hopman have shown that there is usually a relative shortness of the nasal septum as compared with the depth of the postnasal space. Atrophic rhinitis is a purely local disease, not related to other disturbances of health.

Of the numerous speculative views regarding the etiology of ozena, only two need to be mentioned—and to be refuted. Fränkel claimed that ozena is the terminal stage of hypertrophic rhinitis. No one has ever seen this transition conclusively, and the mere presence of a hypertrophic spot in ozena is insufficient evidence. Moreover, ozena begins usually in childhood, before hypertrophic rhinitis is at all common. Bosworth has suggested that his "purulent rhinitis of children" might be the beginning of atrophic disease, but has also failed to furnish positive proofs. According to personal experience, the peculiarities of the purulent rhinitis of children persist so long as the disease lasts and do not change into those of ozena, while it is generally recognized that the characteristics of ozena are present from the start.

**74.** The **treatment** demands the removal of the tenacious pus and the prevention of its desiccation. If the douche used with considerable force does not detach the crusts, they must be picked off with forceps and probe.

The douche should be continued until the water comes out clear. In a few hours the crusts form again. But on irrigating twice a day properly, the secretion soon diminishes, becomes clearer and less tenacious, and crusts can be prevented. An important addition, and to some extent a substitute for the douche, is the tampon introduced by Gottstein. A pledget of cotton of the size of a little finger is pushed up into the nose and replaced in the course of hours as soon as it feels wet. It may be wound on a probe with a screw-thread, which is then withdrawn by rotation, or it may be rolled permanently on a wooden tooth-pick. Its application must be learned by the patient. As long as the surgeon applies the tampon himself, packing with gauze is, if anything, more agreeable to the patient than cotton. If possible without interference with nasal breathing, the tampon may be worn on both sides continuously, otherwise alternately. Its use during the night depends on the patient's tolerance. The tampon starts a more abundant but thinner flow of mucus, which diminishes in the course of some days. The tenacious pus is thus removed more completely by absorption by the cotton plug, while desiccation becomes impossible. If properly applied after a thorough cleansing, the tampon removes all odor within a few days. On stopping the treatment, the odor returns after a time, varying in duration according to the previous improvement. By the use of the douche and the tampon, every case of ozena can be made comfortable and improved up to a variable limit. A small number, perhaps 10 per cent., are completely cured in the course of many weeks. The possibility of cure depends less on the degree of atrophy than the absence of suppuration of accessory cavities.

Grünwald has shown that ozena rebellious to all other treatment can be cured by opening up all foci of suppuration in the different sinuses which may be involved. Quite often the sinuitis is multiple, and may hence require multiple operations. The difficulties of recog-

nizing and curing affections of the accessory cavities (compare Chapters VI. to VIII.) are at present so great that but few reports have appeared confirming or limiting Grünwald's claims. The writer's personal observations are favorable to them, but he can neither share his radical views concerning the all-importance of sinuitis, nor his sanguine statements regarding their speedy surgical cure.

Many other methods of treatment have been recommended, but none have obtained general indorsement. Medicinal applications of methyl-blue, ichthyol, oil sprays, mild caustics, and a host of other measures have found but little favor on tests made by others than their first originators. Electrolysis carried out by means of a copper probe used as negative electrode with a current of from 15 to 25 milliampères for a few minutes has also been found uncertain, although at first highly praised. Massage by means of vibratory movements with a cotton-wound probe, or with an electromagnetic vibrator, seems to have given satisfaction, but definite reports regarding permanent cures are still to appear. Injection of diphtheria antitoxin, a procedure without any theoretic foundation, has been reported curative, but the unfounded and arbitrary reason for this procedure has not attracted much confirmation.

## CHAPTER X.

### ANTERIOR DRY RHINITIS.—PERFORATING ULCER OF THE SEPTUM.—HEMATOMA AND ABSCESS OF THE SEPTUM.—MEMBRANOUS AND DIPHTHERITIC RHINITIS.

#### ANTERIOR DRY RHINITIS (RHINITIS ANTERIOR SICCA).—PERFORATING ULCER OF THE SEPTUM.

**75.** Anterior dry rhinitis is the term applied recently by Siebenman to a frequent nasal affection which had previously been ignored, perhaps by reason of its seeming innocuousness. It is an inflammation of the lower part of the cartilaginous septum, with formation of adherent crusts and tendency to ulceration. On the surface of the cartilaginous septum, barely behind the vestibule and just above the floor of the nose, adherent thin scabs are found—on one side, as a rule. They are not purulent, and look like dry scales of varnish. When detached (with difficulty), the surface underneath is found excoriated and liable to bleed. Later on deeper ulceration may be seen. The disease remains limited to a small area. It has little tendency to heal spontaneously, and may last long periods of time, leading in many instances finally to a perforating ulcer of the septum. As the disease advances the mucous membrane is destroyed, and the cartilage is seen exposed. The ulceration extends through the center of this denuded area, and then spreads centrifugally until a perforation approximately circular and rarely over 2 cm. in diameter results. The disease never extends beyond this stage, but the edge of the perforation may remain excoriated for a long time. Finally this heals too, and nothing but a hole with smooth undeformed edge remains.

During its entire course the disease causes very little

disturbance. The patient complains of slight annoyance from the crusts and is apt to pick at them. Occasionally persistent and repeated bleeding occurs, especially after enfeebling diseases, like typhoid fever. There is no liability to acute inflammation or other complications, but the disease may sometimes be associated with a purulent rhinitis.

**76.** The **cause** of dry rhinitis is not known.[1] The disease is not ordinarily seen in children. Fragments of excised mucous membrane show round-cell infiltration, especially along the course of the blood-vessels, some hyaline degeneration of the mucous membrane, and the presence of plasma-cells. Hemorrhages occur into the tissue, and leave evidence of their presence in the form of yellowish pigment granules, which give the surface a yellowish appearance. Such discolored areas have been described by Zuckerkandl under the name xanthosis. The cylindric epithelium changes into flat cells with keratous degeneration. Later on the epithelium is, of course, lost. The progressiveness is apparently due to changes in the blood-vessels. When it comes to actual ulceration, the diseased area is found infiltrated with cocci, to the presence of which the destruction must be ascribed. The adherent scabs consist of dry mucoserous secretion with very few round cells. Similar adherent and persisting crusts are sometimes seen after surgical wounds in the cartilaginous part of the septum, but in these instances no tendency to progressive ulceration is observed.

**77.** The disease is but imperfectly controlled by **treatment**, perhaps for the reason that patients lack the necessary endurance, in view of the slight annoyance which it causes them. Nitrate of silver applications, 5 to 20 per cent. in strength, exert a distinct, but not always permanent, influence. The crust-formation is controlled by cotton tampons as long as the patient is willing to wear them. Treatment is likewise inefficient after

[1] Workmen handling chrome or arsenical salts or those manufacturing cements frequently suffer from ulceration of the septum.

the ulcer has perforated. Here, too, nitrate of silver applied to the edges is of some benefit. Stronger caustics or the galvanocaustic burner give no satisfactory results. But while we may not be able to check the ulceration, we can be certain of its benign and ultimately limited course.

**78.** It is very important to distinguish between this *benign perforation* of the septum and *syphilitic ulceration.* The former produces little disturbance, never extends beyond an area of about a five-cent piece in size, is approximately round, and its edges are not thickened or deformed and are covered only with thin crusts. It never extends beyond the cartilaginous septum, and when the edges heal, the crust-formation ceases. Syphilitic ulcers, on the other hand, the result of either a circumscribed gumma or diffuse gummatous involvement of the blood-vessels, cause decided disturbance, at first in the form of pain, and later on by reason of the copious secretion and the thick purulent crusts. The edges of syphilitic ulcers are always thickened, infiltrated, and more or less deformed, and the ulceration, if not checked, extends beyond the cartilage into the bony septum. If not controlled, it may cause extensive loss of substance down to the floor of the nose and high up in the bony septum. Such extensive ulcers cause later on sinking-in of the bridge of the nose, which never follows non-syphilitic ulceration. On the other hand, syphilitic ulceration is rapidly controlled by thorough specific and proper local treatment. (Compare Figs. 1 and 2, Plate I.)

## HEMATOMA AND ABSCESS OF THE SEPTUM.

**79.** A very rare occurrence, almost invariably of traumatic origin,—**hematoma,**—is an effusion of blood under the perichondrium of the cartilaginous septum. It occludes the nose and appears as a soft swelling on the septum. It rarely undergoes absorption. As a rule, it lasts a number of days and then changes into an abscess which may bulge on either side or on both sides of the sep-

tum. This usually causes some pain and headache. It is very slow to open spontaneously. When opened widely with the knife, it heals uneventfully. Even if the cartilage has been perforated by the suppurative inflammation, no unpleasant results are apt to follow after the healing.

### MEMBRANOUS RHINITIS. DIPHTHERITIC RHINITIS.

**80.** Inflammation of the nasal mucous lining, with formation of false membranes, occurs under various conditions and from different causes. It is occasionally observed after extensive cauterization, especially surface cauterizations, and in such cases is a strictly localized process. There is but little annoyance beyond slight soreness and obstruction and perhaps moderate bleeding. The grayish membranes are not detached easily, and when removed, leave a denuded surface on which they form again within some hours. It is due to infection by the streptococcus, rarely the staphylococcus, but always follows a benign course, although it may last two to three weeks.

A more diffuse, and hence more annoying, membranous rhinitis occurs, rarely spontaneously, not uncommonly, however, after scarlet fever. This, too, is due to the streptococcus, yet it is only of local importance and causes no systemic disturbance. Like all nasal inflammations, it threatens the ear.

**81.** Indistinguishable in its appearance from streptococcus infection is true **diphtheritic rhinitis.** It causes similar grayish false membranes on a denuded bleeding surface, with rapid regeneration of the membranes after their detachment. The process is sometimes so superficial that it may be termed croupous, while in other cases it involves the depth of the mucous lining, as in typical diphtheria. Yet the disease is of a benign nature as long as it is limited to the nose, and it causes no systemic infection or sequels. The diagnosis of its diphtheritic nature must be based upon finding the bacillus of diphtheria by the microscope or by culture. Its grave

importance is its contagiousness, all the more so as the patient is scarcely sick. Even after the membranous formation has ceased the diphtheria bacilli persist in the nose for weeks. Some of the accessory cavities are probably always involved in the process, harboring the specific bacteria, even if there be no membranous inflammation in the sinus. It is not known why diphtheria limited to the nasal lining has none of the malignancy characteristic of that disease in other localities.

**82.** The **treatment** of membranous rhinitis must depend upon the diagnosis of the parasite causing it. Diphtheria patients must be isolated, even for some time after recovery. Antitoxin should be invariably employed within the first three or four days of the disease. If of longer duration, it is doubtful whether the specific treatment has any influence upon it. In either diphtheritic or streptococcus rhinitis the membrane should be detached gently with forceps as far as it can be done without causing bleeding. No one has recorded a sufficient experience to formulate any rules for medicinal treatment. It is desirable to check secondary bacterial decomposition, but active germicides are not tolerated well by the nasal lining. Sprays of essential oils in watery solution (¶ 25) are of some service if used at very short intervals. Löffler's solution (compare ¶ 25), while momentarily very irritant, can be used (after cocain spray), but its efficacy has not been sufficiently tested.

Much more serious is **nasal diphtheria** when complicating and secondary to diphtheria of the pharynx. Under these circumstances it constitutes one of the most serious manifestations of diphtheria, a great menace to life and always a danger to the ear. Yet it is amenable to the specific antitoxin treatment if resorted to at once. It is, however, mostly in neglected cases of throat diphtheria that the extension into the nose occurs. This complication always involves a very long course—up to many weeks if not treated specifically at the beginning. Further details will be given in Chapter XXIV.

## CHAPTER XI.

### ENLARGEMENT OF THE CAVERNOUS TISSUE. (IRRITABLE NOSE—CORYZA VASOMOTORIA.)

**83.** Enlargement of the venous plexus, with increased vascular irritability, is a lesion associated with various nasal affections, but one which may also occur as a sequel without persisting coexistence of other nasal disease. As certain characteristic nasal symptoms depend directly upon this condition, it deserves special description.

The entire nasopharyngeal mucous membrane is highly vascular, with a decided preponderance of veins in the deeper layer. Around the anterior end of the inferior turbinal, and to a less extent around the posterior ends of both inferior and middle turbinals, the venous plexus in the mucous membrane is massed so as to form a distinct vascular cushion capable of turgescence (see Figs. 8, 9, and 10). Normally, the mucous membrane appears slightly compressible over these areas, showing the normal distention of the vessels by blood. Undoubtedly moderate variations in the vascularity occur during the normal condition, but are not so demonstrable as when the cavernous tissue is increased. Even in a normal nose a visible vascular constriction is produced in these localities by the application of cocain or suprarenal solution. But when the cavernous tissue is morbidly augmented, the changes in its turgescence are very striking. Under the influence of fright or syncope, or upon the application of cocain, the previously swollen mucous membrane shrinks visibly—though without change of color—until it lines the bony contour accurately. As the result of various modes of irritation the vascular swelling may, on the other hand, become so ex-

tensive as to occlude the passages entirely. The course of the nerves—presumably both vasoconstrictor and vasodilator fibers—which control these blood-vessels is not known.

The turgescent area at the front part of the inferior turbinal slopes so gradually toward the rear that its limits cannot be defined, especially as the vascular network throughout the entire mucous membrane over the turbinals differs from pronounced cavernous tissue only in degree. The cavernous cushions on the posterior ends of inferior and middle turbinals are more circumscribed. Their normal pale yellowish-pink color changes into a violet-pink hue when their turgescence makes them appear as globular tumors occluding the posterior choanæ in the postrhinoscopic image. As the result of disease, vascular cushions are sometimes developed in localities where there is normally no cavernous tissue—viz., anteriorly over the tuberculum septi, sometimes on the floor of the inferior meatus, or as part of a hypertrophic protuberance on the septum next to its posterior edge.

Every acute inflammatory attack is accompanied by engorgement of the cavernous plexus. While a single transient coryza leaves no gross change, repeated or prolonged attacks may lead to permanent enlargement of the cavernous tissue. Whether this hypertrophy differs from the original normal structure histologically has not been studied fully. A condition which is of marked determining influence by favoring the augmentation of the vascular structure is the existence of septum irregularities. It is, however, not the extensive deflections or thick prominences causing continuous stenosis which lead to vascular hypertrophy, but rather small spurs and crests which do not perceptibly narrow the passage except while there is vascular engorgement. The larger septum irregularities in connection with any persistent inflammation favor hypertrophy of the entire mucous membrane, which becomes most redundant on the (roomier) side of the septum concavity.

Purely vascular enlargement is readily distinguished from hyperplasia of the entire membrane. In the former case the swelling can be indented with the probe and disappears completely when cocainized. An excised bit of mucous membrane shows normal thickness. In the latter case the probe recognizes the excessive thickness of the lining membrane, which an excision confirms, while after cocain the membrane covering the bone, although somewhat reduced, still shows a distinct augmentation of volume as compared with the normal. Vascular enlargement and actual hyperplasia may be combined to a moderate extent, but any extensive hypertrophy of the mucous membrane as a whole excludes overdevelopment of the venous plexus.

**84.** In subjects giving the history of frequent, though transient, attacks of coryza and presenting some slight surface irregularity of the septum, permanent enlargement of the cavernous tissue without any coexisting inflammatory lesion is occasionally observed. Women are more liable to it than men. It is not common in children. Closer inquiry always reveals in these patients a neurotic condition, sometimes neurasthenia, often hysteria, sometimes mere "nervousness," but always exalted excitability of the nervous system. Quite often, too, the history proves that intestinal disturbances, especially constipation, have been of etiologic influence.

More frequently than as an isolated condition vascular overdevelopment is found in association with other irritative nasal diseases, such as suppuration of the nasal passages or accessory cavities, polypi, or hypertrophic rhinitis in its earlier stages. Under these circumstances, too, the vascular irritability is a mirror of the instability of the nervous system of the individual. Female patients preponderate decidedly. Massive diffuse hypertrophy of the mucous membrane, on the other hand, limits the development of cavernous tissue; advanced atrophic rhinitis excludes it.

**85.** The complaints are partly mechanical, partly

nervous symptoms. In spite of considerable enlargement of cavernous tissue the passages may be clear a variable part of the time. But in the recumbent position, especially during sleep, engorgement occurs in the nostril on the lower side of the head, causing occlusion of the passage. The slight difference in the venous blood pressure produced by turning the head on the other side suffices to transfer the engorgement to the other side, allowing the first affected nostril to clear in the course of a few minutes. Very striking is the alternating unilaterality of the turgescence. Except during acute inflammation or in very irritable subjects with one-sided stenosis, one side of the nose is, as a rule, clear. The same one-sided engorgement can occur in consequence of drafts, dust, or irritating gases and smells. The occluding vascular turgescence is seen on inspection anteriorly. In some instances a similar but more localized engorgement is found at the posterior end of one or both turbinals on examination. The swelling may subside in a short time, or under conditions of irritation may alternate between the two sides for a longer period. Cocain or suprarenal solution reduces it at once. (Comp. Fig. 3, Plate I.)

**86.** In nervous subjects the vascular dilatation may lead to other symptoms. A sneezing fit, sometimes lasting to a distressing extent, with watery secretion, tearing and redness of the eyes, and finally total nasal occlusion, at least one-sided, constitute the attacks of so-called *vasomotor coryza* or *irritable nose*. Their frequency depends very much on the nervous condition of the patient and on the opportunities for irritation.

Some patients possess an idiosyncrasy in regard to certain odors or irritants which give them always a severe fit of vasomotor coryza. Such irritants are ipecac, the odor of roses, and perhaps more frequently the smell of horses. The attacks may pass off in a fraction of an hour, or, when severe, may last many hours. These fugitive attacks, resembling a true coryza in their subjective symptoms, have led to much confusion in litera-

ture, and account for the many erroneous reports concerning the abortive treatment of "colds." It is singular that the sneezing fits and attacks of vasomotor coryza cease entirely during the course of any severe general disease. The astute observer, Jonathan Hutchinson, has asked pointedly, "Who has ever heard a sick man sneeze?" In markedly neurotic subjects these spells may be followed occasionally by fugitive edema (urticaria) of the eyelids, conjunctiva of the eyeball, or skin of the face next to the nose. Attacks of vasomotor coryza may likewise lead to scotoma scintillans with headache, dizziness, or more generally a feeling of confusion or an attack of asthma, sometimes a prolonged fit of coughing (compare Chapter XXIX.). The results of local treatment show that these nervous phenomena depend on the turgescence in the anterior parts, rather than on the engorgement of the rear end of the turbinals.

**87. Treatment** must begin with the search for any local irritative lesions. The removal of a small hidden polypus may end all trouble. Proper cauterization of an inflamed or granulating area, successful drainage of a suppurating sinus or a cyst in the maxillary sinus, may effect a cure. Very rarely a fissure in the vestibule keeps the nose irritable. The removal of spurs and ledges on the septum (see Chapter XVI.) is often an indispensable step for success, but may not be followed by a speedy cessation of the irritability—indeed, may prove insufficient, if not accompanied by cauterization of the cavernous tissue. If removal of the presumable irritative lesion fails to cure the irritability, or in case no other lesion can be found, the vascular engorgement and irritability can be permanently stopped by thorough destruction of the cavernous tissue. When there is only vascular enlargement without hypertrophy of the mucous membrane, the swelling cannot be thoroughly taken away with the snare. Cauterization with trichloracetic acid or superficial cauterization with the galvanocautery gives relief, but no permanent results. The only radical way is deep

cauterization by multiple punctures (¶ 27), one side at a time, followed two to three weeks later by the same operation on the other side. The case should then remain under observation for many weeks, and whenever returning symptoms and repeated examination show the vascular areas still capable of engorgement, these should be successively destroyed. It is very rarely necessary to operate on the posterior ends of the turbinals. By these means, persistently pursued, a permanent cure can be obtained. Cases complaining only of mechanical obstruction are much more readily controlled than the nervous phenomena of neurotic patients. The relief from insufficient operations may gradually disappear, and a relapse may occur, since the remnants of cavernous tissue regenerate readily under the stimulus of acute inflammations or persistent irritation.

Cauterization can be dispensed with or deferred in those patients whose complaints depend on some nervous condition of transient or controllable nature. The nervous nasal symptoms are, for instance, apt to be exaggerated during a pregnancy, to subside again later on. As there are some instances of miscarriage on record, attributable to cauterization, discretion should be exercised. A patient run down by overwork, anxiety, or loss of sleep may become comfortable by proper hygienic management without local treatment. The injurious influence of digestive disturbances upon the nose must not be overlooked. Relief may be obtained by avoiding hitherto disregarded exposure to dust. A trip to the mountains or to any dustless locality with mild climate is apt to give at least temporary benefit.

## CHAPTER XII.

### RETRONASAL CATARRH.

**88.** Retronasal catarrh is characterized by a mucous secretion in the posterior part of the nose, with absence of all gross lesions. The disease—the most frequent of all nasal affections in the United States—is not correctly described in most text-books, and is generally confused more or less with hypertrophic rhinitis. While, indeed, it is often associated with other forms of nasal disease, it occurs in the uncomplicated form sufficiently often to justify its recognition as a disease entity.

The only symptom is the secretion of mucus dropping into the pharynx. The mucus is thick, usually somewhat inspissated, foamy from air-bubbles, and in cities is stained grayish dark by soot and dust. While containing a few round cells microscopically, it is not at all purulent. From the posterior parts of the nose it flows into the pharynx, to be swallowed or spat out. When very viscid, it adheres to the posterior surface of the soft palate and is removed by the familiar guttural gurgling sound of hawking, which throws the palate into vibration. When very abundant, the patient occasionally draws it into the pharynx by a strong nasal inspiration, as he cannot expel it forward. The discharge is not identical with pus formed at the roof of the pharynx in inflammation localized at that spot. In a normal nose there is no secretion whatsoever, sufficient to flow or to collect, except momentarily in consequence of external irritation.

**89.** In uncomplicated retronasal catarrh no gross lesions whatsoever can be detected in the nose or nasopharynx. Such uncomplicated cases are more common among females than males. More frequently, however, retronasal

catarrh is associated with hypertrophic rhinitis, sometimes with other nasal lesions. We may thus find septum deformities and thickening, diffuse localized hypertrophy of mucous membrane on the turbinals, enlargement of cavernous tissue, and hyperplasia of the various areas of pharyngeal adenoid tissue. But none of the lesions are constant or essential. The amount and viscidity of secretion are, however, very much influenced by any interference with the patency of the nasal passages. The disease is relatively rare in subjects with wide passages, while the annoyance from the "sticky" discharge increases with the degree of nasal stenosis. Any obstructing lesion, even transient enlargement of the cavernous tissue, is thus an aggravating factor in the disease.

**90.** The disease, almost unknown under the age of puberty, is common only after adolescence, being more frequent—at least in its associated form—in the male. Every-day observation shows its extreme distribution, as judged by the characteristic hawking noise wherever people meet. On account of the slight annoyance and the absence of sequels, patients with the pure type of the disease do not commonly seek treatment. The disease usually lasts indefinitely, improving in mild weather, but rarely disappearing entirely, except under improved climatic environment.

It is of inflammatory origin, as can be learned in those rare cases which seek advice at the beginning. It is temporarily aggravated by every fresh coryza. In the absence of lesions visible during life and in default of autopsies we can only infer that it consists in a low grade of superficial inflammation localized in the posterior region of the nose.

**91.** There is no *treatment* known which can directly cure a retronasal catarrh and stop the dropping of mucus. In the rare instances of retronasal catarrh with normal caliber of passage,—which we do not see often, since such patients are so little annoyed,—local applications of any kind have proved useless. I base this opinion fully as

much on the history of patients treated by others as on my own negative results. At the most we can give some palliating advice regarding moderation in smoking, proper diet, if required, and attention to the state of the bowels. But in the majority of cases which call for treatment, complicating and prejudicial lesions are found that can be removed with decided improvement in the patient's comfort, though without curing the retronasal hypersecretion in the strict sense of the word. Operations upon existing septum deformities, the snaring of mucous tissue hypertrophies, the cauterization of excessive cavernous tissue, if judiciously done, usually give the patient subjective satisfaction.

## CHAPTER XIII.

### SIMPLE CHRONIC RHINITIS—HYPERTROPHIC RHINITIS.

**92.** Next to retronasal catarrh, chronic or hypertrophic rhinitis is the most common nasal disease in our climate. It is a chronic, more or less diffuse, inflammation of the nasal mucous membrane, which ultimately leads to generalized or circumscribed hypertrophy. There is, hence, no sharp distinction between simple chronic and hypertrophic rhinitis. The symptoms are those common to all chronic nasal affections and are not characteristic of it. Indeed, there may be total absence of all symptoms. It is always associated with some enlargement of the cavernous tissue during its earlier stage. Hence a variable amount of intranasal turgescence is one of its features. Later on, however, when the stage of massive hypertrophy of mucous membrane has been reached, the vascular enlargement and its variable engorgement become of minor importance. The amount of nasal obstruction caused by the cavernous engorgement, and later on by the permanent thickening of the mucous lining, depends upon the original width of the nasal passage. The narrower the passage, or the more encroachment by any circumscribed hypertrophy, the more distressing becomes the interference with nasal breathing. In extreme instances both sides may be permanently insufficient for the passage of air. Such excessive nasal obstruction gives rise often to a feeling of oppression in the head, and may cause irregular dull headache in neurotic subjects. Insufficient nasal caliber necessarily causes mouth-breathing.

There is no discharge peculiar to hypertrophic rhinitis. When not associated with other lesions, especially retro-

nasal catarrh, there is no discharge whatsoever. Usually the mucous membrane is irritable and starts a watery flow upon irritation by dust or from turgescence due to drafts. When a purulent rhinitis coexists with it, the pus present is due to that complication. When there is much diffuse hypertrophy, the sense of smell is often interfered with.

Chronic rhinitis does not pursue a uniform course, but is intensified by every acute attack, and may become nearly latent under favorable surroundings. It rarely ceases permanently in our climate. It may come to a standstill in more favorable localities. Any existing hypertrophies, however, persist.

**93.** While this disease may present few or no symptoms, its importance depends on its possible complications. These are stricture of the lachrymal duct, chronic conjunctivitis, occasionally marked irritability of the eyes, causing asthenopia, hypertrophy of the various pharyngeal structures, among which chronic disease of the lingual tonsil is the most distressing. The disease, furthermore, predisposes to laryngitis and to bronchitis. Its most serious aspect, however, is the liability to extend through the Eustachian tube, causing a hyperplastic process in that passage and in the middle ear.

**94.** On inspection the mucous membrane is found more or less injected. This morbid redness may diminish under favorable influences until the normal pallor is attained. With every acute coryza, however, the injection returns and persists for a while. After the disease has led to hypertrophy of the lining membrane, the acute inflammatory attacks are apt to be milder and of more transient character than in normal nasal passages, but, on the other hand, they occur oftener and always prove more persistent in the end.

Diffuse hypertrophy of the mucous membrane is recognizable only when it has reached a high degree, and can be best observed where the lining passes over some prominence of the bony or cartilaginous frame. The thickened

membrane is often roughened or corrugated. On the surface of the septum the normally minute ridges are exaggerated. The inferior turbinal often presents papillary elevations, especially in the middle and rear regions.

Even when the thickening is not apparent to the eye, the microscope shows in excised fragments inflammatory round-cell infiltration with some increase of connective

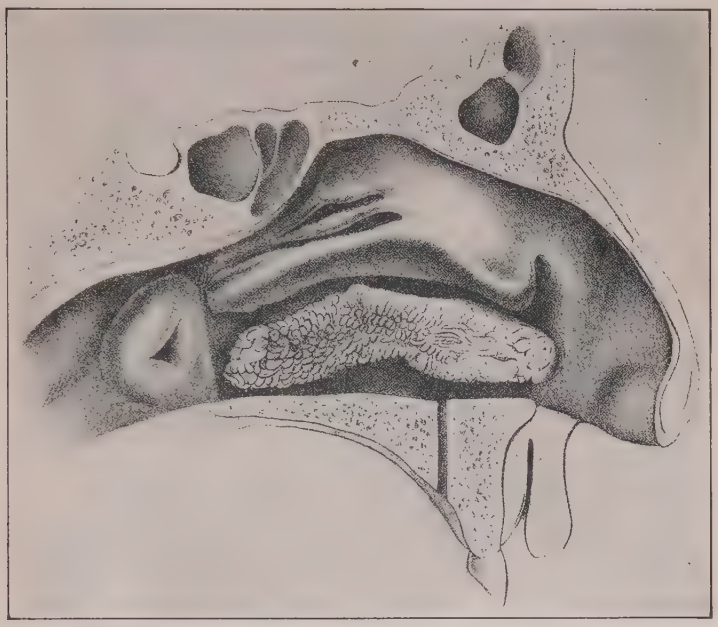


FIG. 50.—Polypoid degeneration of the mucous membrane over the inferior turbinal (Zuckerkandl).

tissue. The ciliated epithelium is partly changed into cuboid cells and often increased in thickness.

Circumscribed hypertrophies can be more easily recognized. They may be limited to but a single locality, or may occur in combination. Occasionally every one of the types to be described is found present. On the inferior turbinal the mucous membrane is distinctly thickened, sometimes forming a flabby, pendant overgrowth. Unlike the pure hypertrophy of the venous plexus this

mucous membrane hypertrophy does not shrink much under the influence of cocain or suprarenal solution. When the veins have retracted under the influence of these agents, the thickened mucous membrane can still be lifted at the free border of the turbinal by the probe. This thickening may be limited to the anterior end or may extend over the entire length of the inferior turbinal (Fig. 50). A well-defined hypertrophy is always found at the front end of the inferior turbinal on the concave (roomy) side of the nose in case of any marked septum deflection. A similar lesion is found less often at the front end of the middle turbinal. Here the redundant

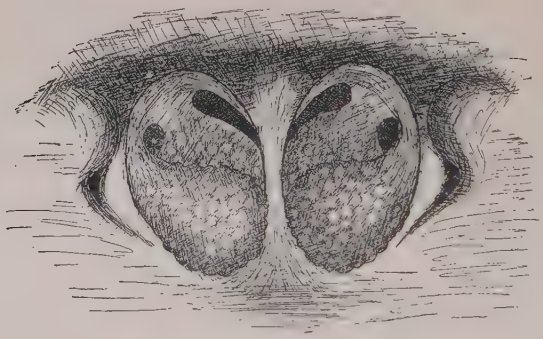


FIG. 51.—Postrhinoscopic view of hypertrophy of inferior and middle turbinals.

mucous membrane may hang down so as to resemble a polypus. True polypi, however, have a distinctly constricted pedicle. Circumscribed hypertrophies may be found at the rear ends of inferior and middle turbinals. In the postrhinoscopic mirror they are seen in the form of semiglobular tumors filling and even occluding the posterior choanæ. Their surface is sometimes smooth, more often wart-like (Fig. 51). When these growths consist of cavernous tissue exclusively, they are of purplish hue and disappear entirely when cocainized. But the more hypertrophic mucous membrane they contain, the more gelatinous and grayish is their appearance, and such overgrowths retract only to a slight extent under

cocain. These lesions can, of course, be observed in the living only by means of the postrhinoscopic mirror. (Compare Figs. 3 and 4, Plate I.)

Deviation of the septum from the median line is an important predisposing condition, and hence often found in hypertrophic rhinitis. The disease itself, however, leads to deformity of the septum by producing lateral crests, ridges, and spurs. The detailed description of these hypertrophic lesions of the septum will be given in Chapter XVI.

A septum lesion peculiar to hypertrophic rhinitis is the cushion-like prominence seen occasionally in the post-rhinoscopic image on one or both sides of the septum, adjoining its rear edge. This is a hypertrophy of the mucous membrane, with more or less cavernous tissue, situated

FIG. 52.—View of the posterior choanæ in the cadaver from the rear, showing polypoid hypertrophies on both sides of the septum (Zuckerkandl).

often, but not always, over a spur on the septum. It appears as a grayish protuberance when seen from the rear, and is somewhat reducible by cocain (Fig. 52).

The clinical history of hypertrophic rhinitis is not complete without reference to the various hypertrophies of the pharyngeal adenoid tissue (tonsils) which commonly occur in connection with it, but which will be separately described in Chapters XX., XXI., and XXII. In fact, in most cases the disease might be called rhinopharyngitis, since the inflammatory and proliferative process extends throughout the entire lining of nasal passages and pharynx.

**95.** Chronic rhinitis results from the prolongation of acute coryza, especially when this occurs in frequent

attacks. It is aggravated by every fresh coryza. A persistence of the inflammation seems to depend largely on any structural peculiarities narrowing the nasal passage. While localized projections which dam up pus help to perpetuate a chronic purulent rhinitis, any diffuse form of stenosis, on the other hand, favors the occurrence of hypertrophic rhinitis. As the disease itself leads to further hypertrophies, its tendency to perpetuation explains itself. It is uncommon in wide passages, and much less common in childhood than after adolescence. Its occurrence in children is favored by hypertrophy of the pharyngeal tonsil. Unfavorable hygienic factors, exposure to drafts and insufficient protection, a poor cutaneous circulation, cold feet, and bowel disturbances predispose to it. There is no reason to doubt that, like most forms of inflammation, it is directly or indirectly dependent on parasitic influences. But no definite form of bacteria has as yet been found associated with it in various researches. The tendency to hypertrophy is evidently an individual peculiarity of which we do not know the conditions. The disease may last long periods of time with scarcely any hypertrophy in some patients, while in others it rapidly leads to the lesions described.

**96.** The **treatment** of hypertrophic rhinitis aims to arrest the disease and to remove surgically any enlargements which exert an unfavorable influence. Since the chronic rhinitis is the outcome and perpetuation of acute inflammation and becomes intensified by every acute attack, the hygienic management must attempt to prevent acute and subacute exacerbations. Attention must be paid to the general health, the digestion, the state of the bowels, the peripheral circulation (cold feet), and the habits of the patient (compare ¶ 16 and ¶ 17). The inflammation itself may be reduced by daily treatment with the spray of essential oils in watery solution (compare ¶ 25). Its influence is augmented by previously reducing the nasal turgescence by means of suprarenal solution in the form of a spray, preferably with the addition of cocain.

Under no circumstances, however, should cocain be given to the patient for habitual use. The douche is entirely uncalled for unless the disease is associated with purulent rhinitis. Localized areas of injected mucous membrane may be brushed with nitrate of silver solution (5 to 10 per cent.), but diffuse applications of this agent, as well as of other so-called astringents,—tannin, iodin solutions, and so on,—have generally no appreciable influence. In fact, it is quite questionable whether the disease can be influenced to any marked extent by medicinal applications of any kind, except during periods of subacute intensification.

Decided benefit can be expected from surgical procedures directed against any hypertrophies of sufficient extent to encroach upon the caliber of the passage. As the disease itself is perpetuated by any interference with the nasal caliber, such surgical procedures influence not merely the spot against which they are directed, but the entire disease. Hence, by properly restoring the patency of the nose, we can practically cure all manifestations of the disease in many instances. Relapses, however, must be expected under unfavorable environments.

**97.** Hypertrophies of the mucous membrane over the anterior end of the inferior turbinal are removed best by means of the cold snare. If not of such shape that they can be grasped securely by the loop, they are first to be transfixed with a needle, over which the loop is then placed. There is but slight bleeding at the time, but often enough later on to require a tampon for the first twenty-four hours. When the enlargement consists of relatively much cavernous tissue with but little hypertrophy of mucous membrane, the snare cannot grasp enough after the action of cocain. Eucain $\beta$, which does not constrict the blood-vessels, is more applicable in such a case. When snaring is not feasible, the hypertrophy may be reduced by the galvanocautery, preferably in the form of multiple punctures without needless sacrifice of surface. A burned wound, however, is always more unpleasant

and requires a longer time to heal than a clean cut. In the case of extensive diffuse hypertrophy of the entire mucous membrane over the inferior turbinated bone in a narrow nasal passage, the most satisfactory operation is partial removal of this process, including the bone. This operation, called turbinectomy, lately much favored in England, is quite useful when properly indicated—in other words, when stenosis is due to the prominence of a projecting hypertrophied inferior turbinated bone. In any other case it is a needless mutilation. The projecting part of the process can be cut off by suitable slender cutting forceps, or even by the wire snare after notching the free border toward the rear with the galvanocaustic burner, in order to insert the snare. It may be also amputated easily by means of a small sharp saw.

Overgrowth of the mucous membrane at the front end of the middle turbinal requires removal by snaring only when sufficiently pendant to be easily grasped by the snare.

Hypertrophies of the rear ends of inferior and middle turbinals require removal whenever they can be seen in the postnasal mirror as distinct encroachments upon the space. These are, however, difficult operations. The most satisfactory instrument is the cold snare. When the operator feels that the loop inserted through the anterior nares has grasped a resisting projection, its position should be verified by the use of the postnasal mirror, or by the finger in the pharynx. The loop may have to be variously shaped and bent before it will catch. On account of the probability of bleeding, it is best to tighten the wire very slowly, and even then the operator must be prepared to plug the postnasal space (compare ¶ 29) if tampons wound on tooth-picks do not control the bleeding. When the wire loop cannot be applied successfully, it will sometimes slip easier into grooves burned into the turbinals. For this purpose a suitably shaped bent burner can be inserted through the nose, while its position is watched in the postnasal mirror. Usually retrac-

tion of the soft palate by the hook or rubber band is required for this purpose. After the burner has been suitably placed, the mirror may be withdrawn and the cautery handle is now brought into contact with the burner meanwhile held by the finger. With a slight withdrawing movement a groove can thus be burned. In the case of very vascular tumefactions which retract under cocain or even in consequence of the patient's anxiety, so that they elude the snare, their obliteration can be accomplished only by the galvanocaustic burner under the guidance of the mirror. Very suitable double-jointed scissors have lately been devised by Fein (Fig. 53). As they are sure to catch the projecting hypertrophy, it can

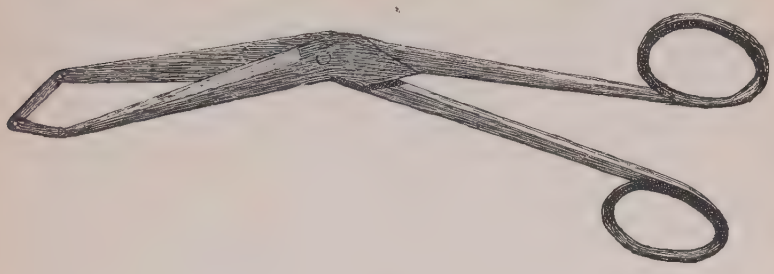


FIG. 53.—Fein's scissors for the removal of the posterior ends of the inferior turbinal.

be cut off promptly. A free hemorrhage, however, is apt to follow.

The cushions of hypertrophied mucous membrane found on the side of the septum near its posterior edge cannot well be reached by any instrument except a flat burner under the guidance of the mirror. By these means they can be easily removed. If, however, they are seated over a projecting spur of bone, they can be better dealt with by any of the operations applicable to septum deformities (compare ¶ 123), especially the spoke-shave.

**98.** A relatively rare, but not unimportant, complication of hypertrophic rhinitis is edematous occlusion of the nasal passages. This occurrence, which the writer

has not found described in literature, has been observed a few times as a sequel to an acute inflammatory attack —usually an attack of influenza in patients previously subject to hypertrophic rhinitis. Both sides of the nose were occluded for weeks by edematous infiltration of the entire mucous membrane. The lining appeared grayish pale and distinctly soggy. There was slight turgescence of the cavernous tissue. The reduction of the turgescence by cocain restored transiently very imperfect nasal permeability. There was no secretion and no lesions were found, except those of hypertrophic rhinitis. The edema was removed, and nasal permeability gradually restored by the use of dilating tampons moistened with cocain solution. As soon as the nasal caliber had been partially reestablished, the existing hypertrophies were removed and the cure thus completed.

# CHAPTER XIV.

## NASAL POLYPI. PAPILLOMATOUS TUMORS.

### POLYPI OF THE NASAL PASSAGES.

**99.** Although but a form of circumscribed hypertrophy of the mucous membrane, nasal polypi present peculiarities which require a separate description. The term polypus is applied to any tumor springing from a free surface by a constricted pedicle. Nasal polypi appear as elongated tumors, usually pendant and freely movable. They are either of a "fleshy" appearance, slightly more reddish than the normal mucous membrane, and of solid consistency, or more generally they are soft and grayish translucent by reason of edema. They vary in size from that of a small pea to the largest masses which can be accommodated by a nasal passage. They are more often multiple than single, more often bilateral than one-sided. Their most frequent points of origin are the free border and external surface of the middle turbinal and the region of the hiatus semilunaris. Smaller ones are often hidden underneath the middle turbinal, springing from the smaller ledges of the ethmoid or from the vicinity of the infundibulum. In rare instances a polypus from the upper part of the maxillary sinus protrudes through the hiatus into the nose. Much less common is their origin from the upper ethmoid structures. Very rarely a polypus is attached to the upper part of the septum. Different, however, from the ordinary polypus is a polypoid bleeding tumor occasionally seen on the septum—the bleeding polypus of the septum (¶ 237). Characteristic polypi do not grow from the inferior turbinal, although sometimes a cavernous hypertrophy may assume a polypoid shape (Figs. 54 and 55).

Polypi are rare in childhood, very common only after adolescence. Zuckerkandl found polypi in over 10 per cent. of unselected subjects in the dead-room.

**100.** The symptoms of polypi are nasal obstruction, more or less proportionate to their size. Patients often feel the moving of the pendulous masses during forcible breathing. When small tumors do not occlude the pas-

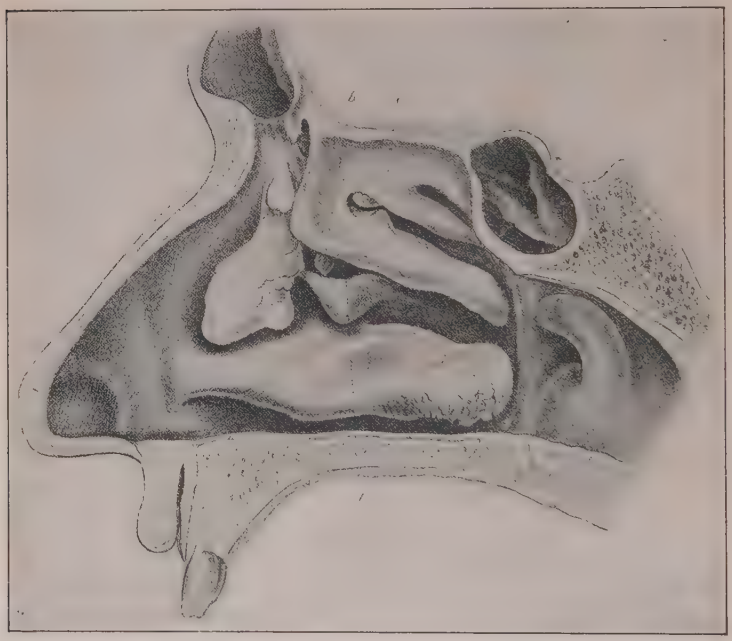


FIG. 54.—External wall of the right nasal passage, with polypi in the middle and the superior meatus and on the inferior ethmoturbinal: *b*, Polypus originating from the middle turbinal; *c*, polypus in the inferior ethmoidal fissure; *f*, dilated infundibulum harboring a polypus (Zuckerkandl).

sage mechanically, they are apt to cause transient obstruction by turgescence. In such cases there is usually much nasal irritability, and sneezing fits, transient watery discharge, and distant nervous symptoms are quite common. The most frequent distant disturbance caused by polypi is asthma. In most instances polypi are associated with purulent rhinitis or suppuration of accessory cavi-

ties, especially the anterior ethmoid cells. There are, however, cases in which there is no discharge. Bleeding is not caused by typical polypi. Occasionally polypi are partly angiomatous in structure, in which case free hemorrhages may occur.

**101.** Histologically, polypi present the structure of mucous membrane with inflammatory round-cell infiltration (Fig. 56). The term myxomatous tumor, formerly

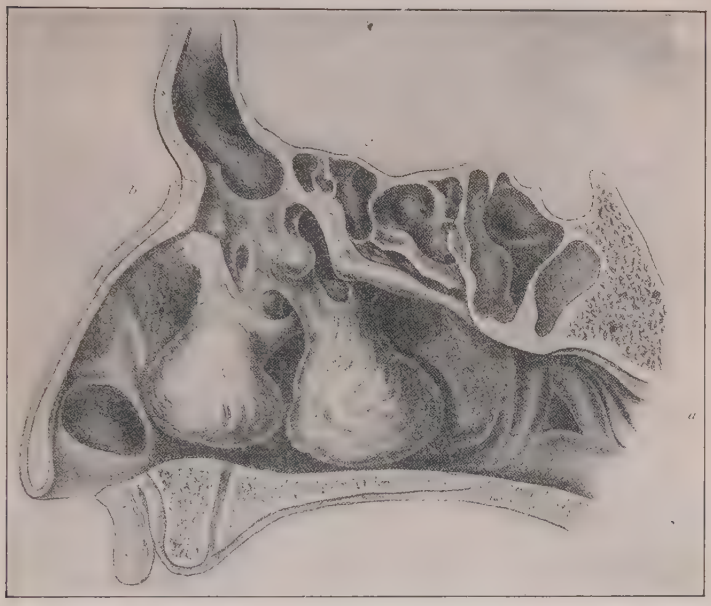


FIG. 55.—Lateral wall of the right nasal chamber, with two large polypi: *b*, Infundibulum; *c*, cyst of the mucous membrane; *a*, accessory maxillary orifice (Zuckerkandl).

applied to them, is hence quite incorrect, as they are neither tumors in a pathologic sense nor do they consist of the embryonal connective tissue which makes up a myxoma. The gelatinous appearance of many polypi is due to edema. This edema is shown by the enormous shrinkage which such polypi undergo upon drying. Under the microscope it reveals itself by infiltration of the tissue with serum, which coagulates when placed in

alcohol. The serous infiltration may distend the meshes of the connective tissue to such an extent as to give some polypi a cystic appearance. True cysts, however, lined by epithelium occur only to a small extent in polypi. The growths are covered by the normal nasal epithelium. Polypi are generally not very vascular, and possess but few nerves. The number of glands found in

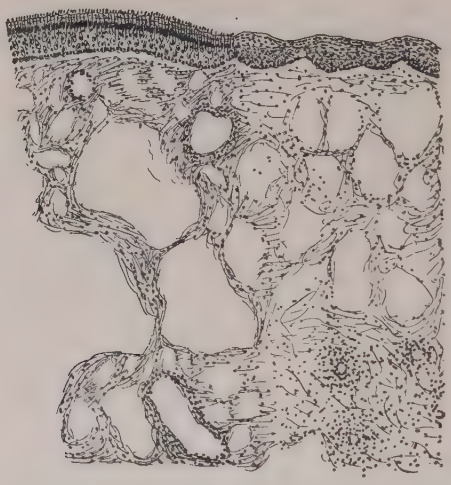


FIG. 56.—Histologic structure of a nasal polypus. The normal stratified cylindric epithelium changes toward the right side to a less regular stratified series of flattened pavement cells. In the areolar tissue are meshes of variable size, filled with serum. There is not much more than the normal amount of cellular (leukocytic) infiltration except around the blood-vessels.

them varies with the area of mucous membrane from which they spring.

The inflammatory origin of these growths is shown by clinical observation. They occur mainly in connection with suppurative disease of the nasal passages or of the accessory cavities. Well-ascertained histories often teach that polypi are started by prior suppurative disease, which their presence then serves to perpetuate. The finding of the polypus should always direct a search for suppuration of accessory cavities, especially the ethmoid cells and the maxillary sinus, for the recurrence of extirpated

polypi may be expected sooner or later if the primary suppuration is not removed. Yet there are instances in which polypi are not accompanied by any form of intranasal or adjoining suppuration. Another condition which is often found clinically as a predisposition to polypus formation is the narrowing of one nasal passage from septum thickening or from deviation. In such cases, however, polypi are usually found on both sides of the nose. Polypi cannot be considered analogous to other hypertrophies of the mucous membrane; for the overgrowth constituting the polypus is not diffuse, but is strictly localized in a small area which continues to grow after it has separated itself from its source by a pedicle. The constriction of the pedicle implies that the growing process takes place only in the body of the polypus. There must hence be some strictly localized stimulus causing this growth. All research for bacteria has hitherto been negative.

**102.** A polypus incompletely removed undergoes rapid regeneration, but complete abscission at the base of the pedicle eradicates it. The removal of a polypus often permits small ones hitherto concealed by it to grow at a more rapid rate, but when the polypi have been completely taken away, their reappearance need not be expected unless some suppurative process persists.

**103.** The removal of a polypus is easily accomplished by placing the snare loop around its pedicle at its base and cutting through. Under the proper use of cocain this is painless and generally not very bloody. If the loop cannot be pushed up to the very base of the pedicle, it is better to tear off the polypus after tightening the wire, rather than to cut it off incompletely. As a rule, some of the mucous membrane from which it springs is thus torn away with it, and the removal is complete. The method of the older surgeons to seize polypi with forceps, especially without the use of the mirror, can only be condemned as inefficient and barbarous. When the polypus is not accessible to the wire loop, its

base may be cut away with a sharp curet. The hot snare has no advantage over the cold wire. The use of the galvanocaustic burner involves the risk of obliterating the orifices of accessory cavities. In the case of narrow nasal passages various accessory operations may be necessary for the complete eradication of polypi. When they are multiple on or underneath the middle turbinal, it is often best to amputate the front end of

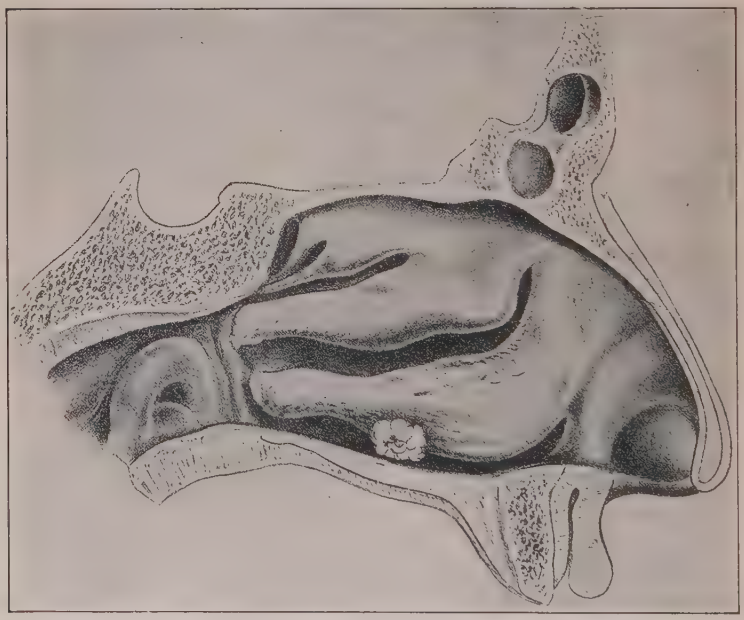


FIG. 57.—Papilloma on the inferior turbinal (Zuckerkandl).

that process. When a thickening of the septum interferes with the accessibility of the growth, some form of operation on the septum may be necessary before the nose can be entirely cleared. After the removal of polypi all hidden foci of suppuration must be sought and cured in order to prevent subsequent growth.

**104. Papillomatous tumors** are localized overgrowths found, as a rule, mainly on the inferior turbinal. In their clinical significance they are analogous to polypi,

differing from them only by reason of the different area of mucous membrane from which they spring. They are much less common than polypi. Their structure is that of the mucous membrane covering the inferior turbinal with inflammatory round-cell infiltration. These growths occur either as hard or as soft papillomata, the difference being due to the preponderance of fibrillary connective tissue in the former, while in the latter the abundant presence of round cells gives them almost the structure of granulation tissue. The name of papilloma is given to these growths on account of their minutely lobulated surface, which thus resembles the papillary structure of the skin. In appearance they may be aptly compared to a raspberry, which they also resemble in color. They occur most frequently in connection with chronic purulent rhinitis, and their presence helps to perpetuate the suppuration. They can be easily and permanently removed by snaring (Fig. 57).

## CHAPTER XV.

### NASAL STENOSIS.—COLLAPSE OF THE SIDES OF THE NOSE.—SYNECHIÆ.—OCCLUSION OF THE POSTERIOR CHOANÆ.

#### NASAL STENOSIS.

**105.** While the width of the nasal passages varies in different subjects with the width of the skull, the normal nose offers no appreciable resistance to the current of air during quiet or even during forcible respiration. Any narrowing or encroachment upon the caliber of sufficient extent to impede the respiratory current is termed stenosis. In default of more accurate physical methods of measurement we can gauge the normal or diminished permeability of the nasal passage by auscultation. When the caliber is sufficient, the ingoing or outgoing air produces no sound, even while breathing forcibly. Any interference, however, with the respiratory capacity of the nose causes a sound varying from a gentle rustling noise to a sharp hiss. The more forcible the breathing, the more distinct is the sound. Either side must be tested while the other is closed by the thumb. In a nose otherwise not diseased stenosis or even occlusion of one side causes no annoyance ordinarily as long as it is compensated by full width of the other. For the animal system has in most of its functions an excess of capacity, and hence some physiologic latitude. But when the breathing is deepened in consequence of severe exertion, the nasal passages of less than average capacity become insufficient, and the individual is "short-winded." If, however, both nostrils are narrowed,—a condition which occurs only in consequence of disease and not merely as a structural anomaly,—the subject feels the difficulty of breathing, and upon the least exertion is forced to breathe

through the mouth. Especially is this the case in the recumbent position (during sleep), when the increased venous blood pressure in the low-lying head causes additional nasal obstruction by turgescence. As the path of the air through the mouth is cut off whenever the tongue arches upward so as to touch the soft palate, which movement often takes place while the mouth is open, the sleep is apt to be interrupted or troubled by momentary dyspnea.

Mouth-breathing, furthermore, subjects the throat and lower air-passages to abnormal and irritating conditions. The inspired air is both warmed and nearly saturated with moisture in passing over the convoluted surface of the normal nasal passage, while the dust it contains is almost wholly deposited there. None of these conditions are fulfilled during mouth-breathing. The cool, relatively dry, and possibly dusty air reaching the pharynx and lower air-passages acts as an irritant. While this irritation by itself is not sufficient to cause local disease, it aids other pathogenic influences, such as infection, in overcoming the resistance of the tissues.

**106.** Nasal stenosis is an important determining condition in the persistence and chronicity of all forms of nasal inflammation. It favors the prolongation of a coryza in the form of a chronic purulent or simple rhinitis. It predisposes in the latter case to the occurrence of hypertrophies, even of polypi. It hinders the free drainage in acute suppuration of the accessory cavities, and thus aids in changing these into chronic affections. Last, but not least, all forms of stenosis exert the most pernicious influence by favoring the extension of inflammatory disease through the Eustachian tubes into the ear. Of all nasal diseases, ozena is the only one the predisposition to which is not augmented by stenosis.

When a one-sided nasal stenosis has become complicated by actual nasal disease, stenotic annoyance is felt by the patient on both sides on account of the variable turgescence of the cavernous tissue, which causes tran-

sient occlusion of one or the other side alternately. The patient may then be at a loss to state which seems to him the narrower side. Nasal stenosis depends principally on the deformities of the septum, which will be considered in the next chapter. But besides the septum irregularities, other structural anomalies may require consideration. Even a considerable degree of deflection of the septum may lead to no morbid results in the case of a naturally wide nasal passage, while in a narrow nose, a relatively slight convexity or ridge on the surface of the septum may cause disastrous consequences. A physiologic septum irregularity which originally caused no stenosis may do so after hypertrophy of the lining of the inferior turbinal has further narrowed the nasal passage. Hence, even when the septum is partly at fault, operations on the inferior turbinal, such as the galvanocaustic destruction of cavernous dilatation, the snaring of hypertrophied mucous membrane, or complete removal of the turbinal process in case of abnormal projection of this ledge or diffuse papillomatous degeneration of its lining are sometimes indicated if the mechanical conditions are not favorable for operations on the septum.

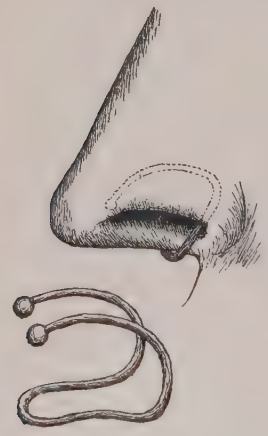


FIG. 58.—Schmidt's dilator for collapse of the external nares, the upper sketch showing it in position. It is made in various sizes.

**107.** A minor condition, but one sometimes deserving attention, is the **inspiratory collapse of the sides of the nose** (alæ nasi). Although itself the consequence of some intranasal anomaly causing stenosis, it intensifies the latter. With every inspiration the sides of the external nose sink in, thereby slightly narrowing the vestibule. It occurs in connection with long-standing

intranasal stenotic lesions, and only in subjects whose alæ nasi are very thin and flexible. It probably depends on insufficient activity of the dilating muscular fibers. The want of breath which the patient feels is relieved at once by keeping the nostrils open—for instance, by the speculum. Temporary relief may be obtained by the use of the wire dilator devised by M. Schmidt and constructed by Feldbausch. Its application is shown in Fig. 58, and may be varied slightly by bending the wire frame. It is made in three sizes. Occasionally its temporary use is followed by permanent relief. By other surgeons silver tubes have been used for the same purpose, but these are often not so well tolerated as a wire dilator which does not touch the septum.

## NASAL SYNECHIÆ.

**108.** Connecting bridges between the septum and the opposite external wall are formed under various conditions. Their most frequent cause is insufficient care after operations, bloody or caustic, in narrow passages, when two denuded opposing surfaces are not prevented from

FIG. 59.—Luer forceps (especially adapted for the removal of intranasal synechiæ).

growing together. A lateral crest on a convex septum may touch the inferior or middle turbinal and consolidate with it when the points of contact are involved transiently in an acute inflammation. Broad or multiple synechiæ are very often due to nasal syphilis. In some cases synechiæ are of congenital origin. They are mostly

membranous, but occasionally bony. Sometimes irrelevant, they may in other instances cause stenosis or dam up secretions. Again, they may be the starting-point of nervous, so-called reflex, disturbances. They are easily removed by any form of broad rongeur forceps (Fig. 59), which exsects the whole bridge. If curvature of the septum renders them less accessible, they may be cut through at one side and then snared off, or removed with the spoke shave. The broad synechiæ of syphilis may, however, tax the surgeon's ingenuity to the utmost.

**109. Total occlusion of one nostril at its anterior vestibular entrance** has been observed a few times in consequence of destructive processes (syphilis, lupus, small-pox, and rhinoscleroma).

**110. Total occlusion of the posterior choanæ,** while not a frequent occurrence, is on record in more instances than anterior closure of the nose. It is always congenital, and may be one-sided or bilateral. The one-sided closure causes scarcely any annoyance so long as the nose is otherwise healthy; only the sense of smell is abolished on that side. Any form of inflammation, however, leads to the retention of secretion and subsequent annoyance. The closure is membranous in some cases. In others it consists of bony plates springing from the palatal bone.

The diagnosis of choanal closure must be confirmed by the use of the postrhinoscopic mirror, which shows a diaphragm across the choanæ. If this is membranous, it can be easily cut through. Should it not be possible to exsect it sufficiently, the galvanocaustic burner may be used. Operations on bony plates closing the choanæ are more difficult. They are painful and bloody. The posterior wall of the pharynx must be guarded by the surgeon's finger, or, still better, by a suitable bent plate introduced through the mouth. The diaphragm can be pierced by a stilet, and the opening enlarged by the saw or chisel. It is much better to make a large opening at

once than to attempt to enlarge it subsequently by any mechanical means. Sometimes a tube must be worn for weeks. Among the recorded operations, some of them of recent date, there have been various accidents, such as middle-ear infection and even an occasional death.

# CHAPTER XVI.

## ANATOMY OF THE SEPTUM.—DEVIATION OR DEFLECTION OF THE SEPTUM.—LATERAL CRESTS.—DEFORMITY OF SEPTUM BY FRACTURE.

**III.** The two nasal passages are separated by a median wall common to both—the septum. This is made up in front and below of the quadrangular cartilage, in its upper portion of the vertical plate of the ethmoid bone, while its inferior posterior part is the vomer. The extreme anterior tip is membranous and consists of skin. A dense perichondral membrane covers the cartilage underneath the mucous membrane, while the bony plates have a periosteal lining. In its upper anterior region the mucous membrane is thickened into a tumefaction—the tuberculum of the septum—rich in glands and veins. Some distance above the floor the mucous membrane forms a series of shallow ridges during development, which usually dwindle later on, but sometimes enlarge in hypertrophic rhinitis (Fig. 60).

During its early fetal formation the septum is a single plate of cartilage reaching from floor to roof. About the second month the *vomer* becomes differentiated in the form of two ossifying parallel plates, joined in front, below, and behind, but including between them the original cartilaginous layer. Toward birth these two bony plates coalesce, with disappearance of the included cartilaginous plate. At the upper border, however, the bony plates are still separated by a groove in which a strip of cartilage persists. By this time the vertical plate of the ethmoid, too, has ossified from above downward, and now joins the upper border of the vomer, leaving still the strip of cartilage now incased by bony

walls. This condition may change to complete ossification during adult life, or may persist indefinitely.

**112.** The developed vomer represents a stout bony lamella, the height of which increases from before backward, by reason of the slope of its upper or anterior border. Its inferior border articulates with a narrow ridge at the median junction of the two superior max-

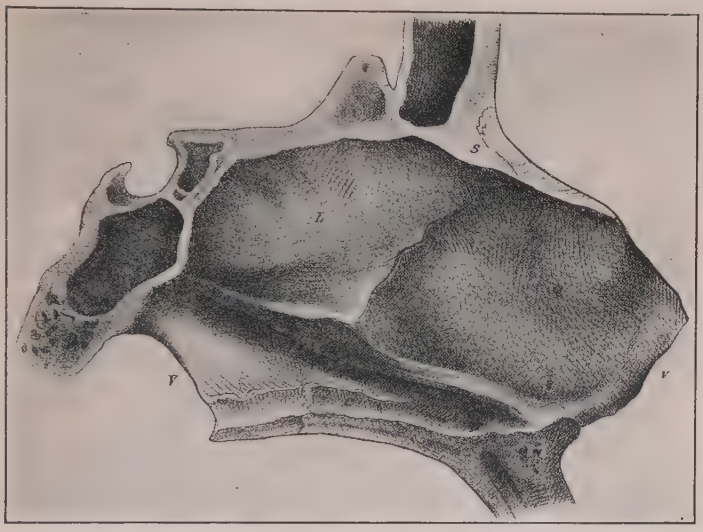



FIG. 60.—Nasal septum after detachment of its mucous lining: *L*, Perpendicular plate of the ethmoid; *V*, *V*, vomer; *Q*, quadrangular cartilage; *S*, nasal spine of the frontal bone; *C*, nasal crest of the palate bone (Zuckerkandl).

illary and the two palatal bones, reaching thus from the front to the rear end of the floor of the nose. The sloping anterior border connects partly with the quadrangular cartilage, and back of it with the vertical plate of the ethmoid. It runs up to the rostrum or spine on the inferior surface of the sphenoid, where it turns to form the short (superior) border articulating with the rostrum. The posterior free edge of the vomer slants upward and backward and is concave.

The *quadrangular cartilage* articulating in front and above with the nasal bones forms the median wall of the

external nose. The triangular cartilaginous plates of the sides of the nose are joined to it. Its inferior anterior rounded corner is framed by the short, thick, membranous septum, which thus completes the middle wall of the external nose. The inferior border of this cartilage rests on the anterior half of the vomer. At this contact the edges of cartilage and bone are sometimes square; more often, however, the cartilaginous edge is bent toward one side and overlaps the bony junction, or is split overriding the bone on both sides, while the vomer may or may not have its groove obliterated. These irregularities of the junction are the starting-point of morbid crests.

The vertical plate of the ethmoid completes the gap between the roof of the nose, the anterior surface of the sphenoid bone, the upper border of the vomer, and the cartilaginous septum. The ossification of this bony lamella proceeds from above downward and extends forward to a variable extent, so that while the bridge of the nose is mostly supported by this bony plate, it rests occasionally only on the cartilaginous septum. The ossification is completed by the sixth year, at the latest about the ninth year of life. But, as before described, a strip of cartilage usually remains after this period, for a variable length of time, incased by bony walls—viz., by the inferior edge of the vertical ethmoid plate and the trough formed by the upper border of the vomer. The lateral crests so often found in the nose are due to hypertrophy of this cartilaginous remnant, with secondary bulging of the sides of the bony trough.

**113.** The normal septum is not always an ideal straight wall. **Asymmetry** due to curvature is found in more than one-half of all skulls of the white races. In uncivilized tribes **septum deviations** occur only to the extent of about 25 per cent. The deflection pertains principally to the cartilaginous portion, but may involve, to a variable extent, the perpendicular part of the ethmoid plate. The deflected septum is convex and bulging toward one side and correspondingly concave on the

other. The curvature is usually more marked in the vertical than in the horizontal plane. The convexity may be scarcely noticeable, or may, on the other hand, occlude practically the one nasal passage. Sometimes a double S-shaped bend is met with, reducing the patency of both sides. When the asymmetry extends to the front portion of the septum, the external nose is deflected to one side. Occasionally, but not often, the free anterior end of the cartilage is deflected and then usually thickened, so as to occlude partly one side of the vestibule (Fig. 61). The architecture of an asymmetric septum is very often complicated by the existence of lateral

FIG. 61.—Stenosis of the right nostril by thickening and deflection of the anterior end of the septal cartilage. The membranous septum is displaced to the left, and thereby narrows the left nostril.

crests on one or even both sides, which thicken it and augment its injurious mechanical influence.

Regarding the causes of asymmetry of the septum, many unfounded hypotheses have been recorded. But nothing more positive can be stated than that it is the result of a disproportionate growth of the septum as compared with that of the rigid bony frame within which it is contained. In very pronounced cases of curvature it is sometimes apparent that the concavity of the septum corresponds to the smaller maxillary bone, which has not attained the growth of its mate, giving the entire face an asymmetric expression. Pronounced asymmetry is rarely observed before the second dentition. The influence of traumatism, so often quoted, has been much overrated. It does seem in some instances to lead

to an exaggeration of a preexisting asymmetry, but it is scarcely probable that it can cause a deflection without fracture of a previous straight septum.

**114.** Less frequent, but clinically more important, than deviations of the septum are the **lateral crests,** also called spurs and septal ridges or spines. They occur in about every third skull and are often associated with some deflection. The lateral crests are protuberances on

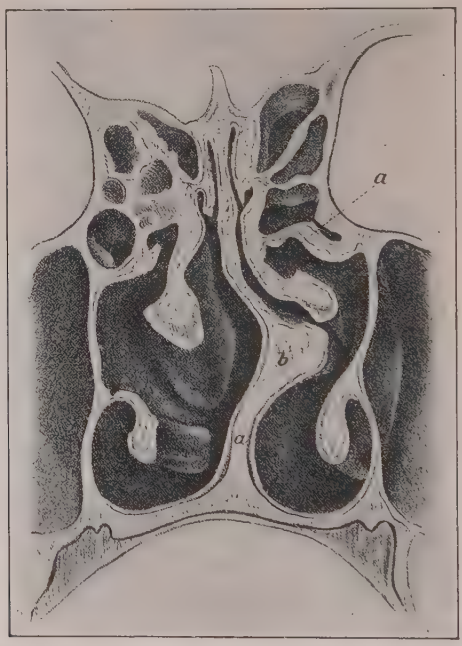



FIG. 62.—Frontal section through the nose, showing a large crest on the left side of the septum: *a*, *a*, Septum; *b*, crest (Zuckerkandl).

the side of the septum in the form of ledges running backward and somewhat upward. They begin usually in the cartilaginous portion, but sometimes only at the bony part, and may or may not extend up to the sphenoid bone. In the cartilaginous portion they may or may not be double-sided. In the bony part they are, as a rule, one-sided, and if bilateral, one is much more prominent than the other. These protuberances may be

scarcely prominent, or may extend laterally far enough to touch the inferior and toward the rear partly the middle turbinal (Fig. 62). The rear end of a lateral crest is sometimes covered by hypertrophic and turgescent mucous membrane in the form of the gelatinous cushion described in ¶ 94. In some instances sharp, cornice-like projections, the lateral crests are in others diffuse flat tumefactions. Their location is at the side of the anterior sloping border of the vomer, anywhere from its front to its rear end, but their parallelism with this border may be masked by their variable and irregular height. By the older writers the spines on the septum have been incorrectly termed ecchondroses and exostoses. These terms are not applicable, as they refer to localized tumors of progressive tendency, and of a structure which the lateral crests do not possess.

The mode of origin of lateral crests has been definitely established by Zuckerkandl. In the anterior part of the septum the lateral spurs or prominences are due to the lateral overriding of the edge of the cartilaginous plate over the edge of the vomer, with more or less hypertrophy of the displaced cartilaginous edge. Further back, where the vomer and the vertical plate of the ethmoid meet, the lateral crest is due to hypertrophy of the strip of cartilage, which persists in the interior of this articulation, incased within the trough-like border of the vomer. This hypertrophy causes bulging of the bony shell which covers it; hence the outer wall, at least, of the lateral crest is bony; indeed, sometimes a very solid bony plate. Quite often, however, the hypertrophied cartilaginous strip itself undergoes later on ossification, in which case the lateral crest is bony throughout. The cause of this hypertrophy has not been fully ascertained. Clinical experience points to an inflammatory origin, for it can often be learned that in noses which had previously presented no lateral crest, such a prominence has gradually developed during the course of repeated acute attacks of inflammation. The side toward which the

bulging of the enlarged cartilage occurs is partly determined by the previous shape of the septum. When this is deflected, the crest is, as a rule, on the convex side. The presence of the crest seems to increase the septum deformity, and in such cases the concavity on the opposite side of the septum is often very deep. Within the cartilaginous portion lateral ridges may occur on both sides, even in a deflected septum. Traumatism may play a slight rôle occasionally in exaggerating the growth of lateral crests, but careful criticism does not lead to the belief that it is a common or essential condition.

**115. Deformity** of the septum as **the result of a fracture** is much less common than the previously described asymmetries. According to Zuckerkandl's numerous dissections and experimental tests, fracture of the septum can occur only in connection with fracture and dislocation of the nasal bones. As this accident, unless promptly treated, always leads to lasting deformity of

FIG. 63.—Old fracture of nasal bones. The cartilaginous septum is bent to a high degree, and on the left side touches the external wall in front (Zuckerkandl).

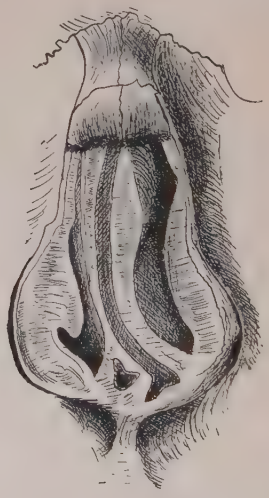


FIG. 64.—Old fracture of the nasal bones. Dislocation of the cartilaginous septum at its articulation with the vomer (Zuckerkandl).

the bridge of the nose, the presence or absence of the latter can guide the diagnosis. Fractures of the septum pertain essentially to the cartilaginous plate; much less so to the vertical plate of the ethmoid. The vomer seems to be protected by its strength and its deep situation. The fractures are usually horizontal; much less often, vertical. The fractured ends overlap and often become thickened. Within the cartilaginous portion they are reunited by connective tissue. In the bony portion only a thin callus is formed. The deformity resulting from fracture is a sharp, angular bend, usually with very great thickening of the mucous membrane on the concave side. A traumatism sufficient to break the nasal bones may also dislocate the cartilaginous plate over the vomer edge, causing thus an excessive thickening in front, near the floor of the nose (Figs. 63, 64, 65).

FIG. 65.—Fracture of the cartilaginous septum with obstruction of the anterior ends of the nasal passages.

**116.** Another tumefaction on the septum, while not uncommon, but of relatively little clinical importance, is the *hypertrophy* of the cushion of mucous membrane in the anterior upper part, known as *tuberculum* of the septum. This may be thickened by hypertrophy of the mucous membrane, with more or less overdevelopment of the venous plexus. Even when very thick it does not interfere with the current of air, but it may interfere with the drainage of secretions to a sufficient extent to justify its reduction by the galvanocautery or its abscission with a knife.

**117. Clinical Significance of Septum Deformities.**—The disturbances due to irregularities of the septum de-

pend upon their mechanical influence. Deviation of the septum is in no sense of the word a disease, merely an unfavorable structural anomaly. Lateral crests, while really a morbid overgrowth, are likewise of significance only if they interfere with the permeability of the nasal passage. The most important effect of septum deformities is the stenosis which they may produce, and this depends upon their prominence, as well as upon the natural width of the nasal passage. If no stenosis sound is heard during examination, it must not be concluded that the septum prominence is harmless, for it may lead to partial occlusion whenever the venous plexus is turgescent, and certainly will do so during inflammatory attacks. A one-sided stenosis, if compensated by full width of the other passage, does not necessarily lead to annoyance nor to disastrous results, so long as the nasal mucous membrane is healthy; it merely makes the patient short-winded on exertion. But it is an important condition favoring the persistence of any inflammation. Hence repeated or severe attacks of coryza are very apt to lead to hypertrophic rhinitis under these circumstances. Clinical observation shows also the importance of septum irregularities in the maintenance of suppurative rhinitis or suppuration of the accessory cavities, the occurrence of polypi, and in the extension of nasal disease to the pharynx, larynx, and bronchial tubes. The most striking observations are those which show the influence of one-sided stenosis together with inflammatory nasal disease in the production of ear disease. This may be either acute or it may be a chronic adhesive process extending through the Eustachian tube in the middle ear. In the case of one-sided nasal stenosis a one-sided ear affection occurs almost invariably on the narrow side, very rarely on the other side. In bilateral ear disease the side most severely involved corresponds in the overwhelming majority to the narrower side of the nose. Quite often, too, ear affections

persist in spite of all treatment of the ear until the nasal stenosis has been successfully relieved by operation.

The pernicious influence of nasal stenosis has been ascribed to rarefaction of the air behind the narrowed part of the passage during every inspiration. It has been assumed that in consequence of this increased negative pressure, a permanent congestion of the mucous membrane occurs. This hypothetic, but plausible, view does not fully explain all the injurious effects resulting from stenosis. It is very noticeable that in deflection of the septum the inferior turbinal shows, as a rule, pronounced hypertrophy of the mucous membrane on the concave, roomy side of the nose.

A septum irregularity which does not sensibly interfere with the passage of air may interfere with the escape of morbid secretions to such an extent as to favor the persistence of suppurative processes. Hence, the operative removal of spurs and ledges often permits the cure of previously unyielding nasal suppuration.

Lateral crests may also be the source of nervous disturbances in irritable noses. In the majority of cases of vasomotor irritability lateral prominences are found on the septum. It is especially those with a sharp edge which seem to irritate most. Even greater importance can be attributed to lateral crests which extend far enough laterally to touch the inferior or middle turbinal, be it permanently or only during periods of turgescence. Some of the most satisfactory cures of nasal irritability can be obtained by the removal of such ledges, even when they do not cause the auscultation sound of stenosis. A crest which extends far enough to touch a turbinal process may become united to it by a bridge of mucous membrane, causing a nasal synechia. This junction seems to augment sometimes the pernicious influence of the crest. On the other hand, very prominent crests may cause localized atrophy of the turbinal process where they come in contact with it.

**118.** The **diagnosis** of septum irregularities is self-evi-

dent from their description. When the anterior region of the nose is narrow, it is necessary to explore the deeper part thoroughly with the probe under good illumination, in order to get a clear picture of the extent of the septum irregularity. The indications for operative interference are very plain, and the results eminently satisfactory in all high degrees of septum irregularities. But in minor degrees of septum asymmetry and thickening the mechanical chances for success are not so favorable. Hence in such cases it must be carefully considered whether the disturbances observed are principally due to the encroachment of the septum deformity upon the nasal caliber, or whether they are due to any coexisting hypertrophies on the external nasal wall, as the latter are more easily removed by operation. Small and insufficient operations on the septum are, as a rule, to be deprecated as useless. An incompletely removed lateral crest is very likely to continue its growth; for if we remove only the bony shell covering the hypertrophied cartilage nucleus, the latter will grow again later on.

Many surgeons, including the writer, have been tempted to obtain straightening of a deflected septum or atrophy of a lateral crest by some form of continuously applied pressure. But hitherto all these attempts have proved failures. Pressure by tampons, tubes, or metallic springs leads to ulceration of the septum if kept up, and if discontinued, its effect is soon lost. Successful operations upon septum deformities have been extensively practised only within the past fifteen years. The operative attempts of the older surgeons, tried merely in extreme cases, were mostly failures. In the present treatise only those operations generally recognized can be considered.

**119.** The simplest and most satisfactory correction of a deviated septum is the operation devised by M. J. Asch, which can be done in a few minutes. Its object is to fracture the cartilaginous septum and to let it heal in a straight position. General narcosis is usually employed, with the head hanging over the edge of the table on ac-

count of the sharp bleeding. A tolerant patient, however, can bear it under cocain, especially when injected into the mucous membrane. The nose should first be explored for adhesions between septum and external wall, and if found, they should be cut with cutting forceps or a concave gouge. The straight Asch forceps are then introduced horizontally, with the narrow blunt blade on

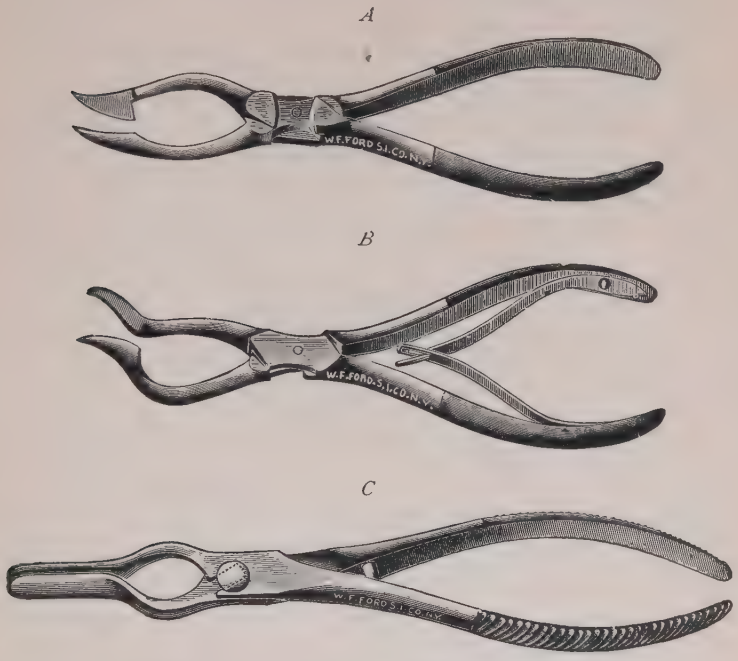



FIG. 66.—Asch's instruments: *A*, Straight scissors; *B*, angular scissors; *C*, compressing forceps.

the narrow side (Fig. 66). The cartilage is cut through, exactly over the apex of its convexity. The scissors are then inserted as nearly vertical as possible, so as to make a crucial incision, splitting the cartilage into four flaps. When the straight scissors cannot be well inserted for the vertical cut, the more cumbersome bent scissors may be employed. The finger is now put into the narrower side, and the fragments are crowded over to the other.

The cartilaginous flaps should be fractured at their base. The Asch compressor is then inserted, and the fracture completed with the intention to render the septum as nearly straight as possible. Asch does not advise fracturing the bone, even if the latter be deflected. The sharp hemorrhage can be controlled quickly by an iced spray or temporary tampons. As soon as this is checked, the Asch or (improved) Mayer tubes are inserted. They are made of rubber, perforated, and somewhat curved (Fig. 67), oval in cross-section, and in six sizes. They bear sterilizing by boiling. The largest one possible is inserted on the formerly convex side until concealed within the vestibule. Its object is to keep the septum straight while healing. The smaller one is put into the other side for the first twelve hours, in order to guard

FIG. 67.—Mayer's hollow nasal splints.

against bleeding, and is then omitted permanently. The tube on the formerly convex side is removed once daily for cleansing, and the nasal secretion is cleared away by a spray. The removal and reinsertion should be painless. The patient can learn to do it himself after a few days. The healing is completed in three and one-half to four weeks, when the tube can be left out. The fractured fragments overlap on the formerly concave side, and their edges sometimes thicken later on. Occasionally this requires shaving off with the scalpel, or slight touching with a burner.

The operation gives ideal results in the case of a curved, bent, but not thickened septum, with plenty of room on the concave side. When a moderate-sized lateral crest complicates the septum deflection, it may be removed

(¶ 122) just before the septum is fractured. With very diffuse thickening, however, or stenosis on the concave side the Asch operation is not applicable.

**120.** For extreme cases of septum curvature, even if complicated by lateral crests, a more radical operation has been devised by Krieg and cultivated especially by Boenninghaus. It is the resection of the deflected cartilage. On account of its tediousness the German surgeons usually operate under cocain and without narcosis. Without speculum two incisions are made at the beginning of the curvature on the convex side, one parallel to the floor, the other parallel to the bridge of the nose. The incisions go through the mucous membrane only and are not quite 1 cm. long, on account of the free hemorrhage following, which must now be stopped. Suprarenal solution aids more than mere tamponing. The triangular flap-membrane thus outlined is then pushed back with a large blunt periosteum scraper. Hereupon the incisions can be extended gradually as far as necessary, until the entire curved part of the septum is exposed. The detached mucous membrane is temporarily pushed out of place by crowding it upward and back. In the next place the incision is extended through the cartilage itself, with care not to wound the mucous lining on the concave side. This may be guarded against by putting the finger into the concave side. This step can also be facilitated by lifting up the mucous membrane on the concave side by means of submucous injection of fluid (with cocain). Perforations are not always avoidable. The incision through the cartilage is extended by means of scissors, always with the same care to spare the mucous membrane on the other side. The liberated cartilaginous triangle now shows the tension under which it was restrained, and bends further toward the external wall. It is seized with stout rongeur forceps and broken off piecemeal. This gradual removal of the deflected plate must extend to the bone if necessary. At the same time lateral crests are taken away in the same manner, so as to clear the

nose entirely. There is very little hemorrhage during the work upon the cartilage. The bleeding comes mainly from the cuts in the mucous membrane. After a sufficient extent of the deflected septum has been removed, the operation is finished. The wall between the two nasal cavities now consists only of the intact mucous membrane on the concave side. Krieg and Boenninghaus do not attempt to preserve the lining on the convex side, as they claim that it rolls up and cannot be stitched in place. (But by much care it can be preserved, at least partially, and the time of healing shortened by the temporary use of carefully inserted tampons which retain it in place.) The great advantage of this operation is the fact that practically no after-treatment is necessary. The wound heals in seven to eight weeks, but requires no special care. The result is a perfectly straight septum. No sinking in of the bridge of the nose has been observed or needs to be feared.

Partial resection of the cartilage has been practised by the writer in deflection occurring at the extreme front end of the septum, especially when the free border adjoining the membranous septum is bent and at the same time thickened. In cases of this kind the obstruction is comparatively within the vestibule (see Fig. 61). No typical operation is suitable for all cases, but by cutting upward or downward with a knife the cartilaginous projection is abscised flush with the normal plane of the septum. It is sometimes possible to save part of the mucous membrane by detaching a flap, as in the Krieg operation.

**121.** Lateral crests of the septum can be removed easily by the saw, according to the method of Bosworth. A thin saw, mounted on a shank bent at an obtuse angle, is introduced in the plane of the septum, and with a steady to-and-fro movement the entire ledge is sawed off. Usually the teeth of the saw are underneath, but sometimes it is more convenient to use it reversed and saw upward (Fig. 68). It is sometimes difficult to detach completely the sawed-off crest, in which case its rear attach-

ment is separated either by use of the snare or by scissors. The use of suprarenal solution facilitates the work by making it almost bloodless. It aids, besides, the action of cocain, so that a pledget wet with 20 per cent. solution will give perfect painlessness after five minutes' application. Subsequent hemorrhage may render temporary tamponing desirable. The wound heals smoothly in

FIG. 68.—Nasal saw.

from one to two and one-half weeks, according to its size; more slowly, however, if it be ragged or irregular. The results are perfectly satisfactory if a sufficiently large piece has been removed. When the sides of the crest slope very gradually, it is difficult to use the saw properly. This is also the case when the ledge extends up to the sphenoid surface.

Some surgeons like M. Black claim to facilitate the operation by using a saw driven mechanically by the

FIG. 69.—Author's nasal chisel (two-thirds size).

rapid rotation of the hand-piece of a dental motor. Others prefer the use of a chisel and mallet, which is a matter of individual preference or skill. There are cases where there is so much slope on the upper and lower sides of the crest, with a relatively square front surface, that the chisel is more applicable. The writer has devised a hollow chisel of elliptic cross-section, of which

only one-half has a cutting-edge (Fig. 69). This instrument, pressing itself against the external wall, cannot slip like a plane chisel, and is bound to gouge out the projecting ledge. It is of service in the case of very broad diffuse tumefaction, especially when situated on the convex side of a nearly plane septum. It is, however, apt to cause perforation, which, in the writer's experience, has not proved a serious objection.

**122.** In the case of crests difficult to saw by reason of their sloping surface a very serviceable instrument is the trephine run by a motor with a dental handpiece. As it is difficult to hold this instrument steady, the writer uses it under the guidance of a sheath into which it fits closely (Fig. 70). This cylindric sheath has one half of its

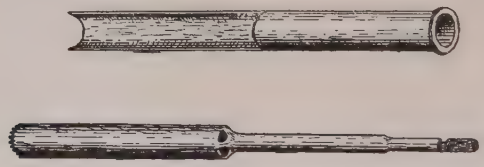


Fig. 70.—Nasal trephine, with author's guarding sheath (two-thirds size).

periphery removed, so as to hug the ledge upon which the trephine is to act. When the crest consists of such hard bone that the trephine gets caught, a smaller one is first used within the same guard to perforate the crest longitudinally and weaken it thereby, whereupon the larger trephine easily cuts it away. Work with the trephine is much quicker than with the saw. It can be used, too, to good advantage in order to reach up to the rear end of crests extending up to the sphenoid surface. As the entire width of the trephine is only 8 mm., it can merely cut a groove with a radius of about 4 mm. In the case of broad ledges the guard is withdrawn after the first cut and reapplied slightly turned, so as to inclose now the balance of the tumefaction, which a second action of the trephine thereupon re-

moves satisfactorily. The only objection to the trephine is that the wound made by it is concave, and its healing is more likely to be delayed by crust-formation than the plane wound made by the saw.

Lateral ledges and spurs limited to the cartilaginous portion can be cut off smoothly with a sharp knife.

When the contour of a crest has so gradual a slope —for instance, on the convexity of a curved septum— that it is difficult to apply the knife properly, the spokeshave which cuts backward can often be substituted advantageously (Fig. 71). The instrument is pushed in until its cutting-edge surrounds the spur from the rear.

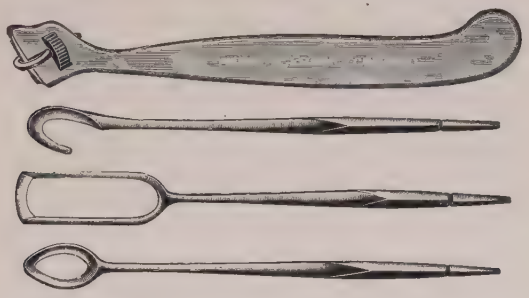


FIG. 71.—The spokeshave in two sizes. The third knife, in the shape of an incomplete ring, is used when a total stenosis hinders the introduction of the other forms. Universal handle for nasal instruments (one-half size).

On pulling it out with the necessary strength while keeping it pressed against the septum even hard bony crests can be abscised thoroughly in one sweep without danger of accidental injury. The same instrument may be used to smoothen uneven wounds made by any other mode of operation.

**123.** The wounds made by these various modes of operation heal kindly, as a rule. The hemorrhage may persist for hours, but is not serious. An aseptic healing cannot be guaranteed, but is usually obtained, especially as long as the passage is evenly packed with iodoform gauze. Where the patient had previously not been able to breathe through that side of the nose, this packing is

not complained of. But most patients without previous complete stenosis prefer the slower healing with unobstructed passage to the advantages gained by a gauze tampon. The best but still not absolutely reliable substitute for iodoform gauze the writer has found in glutol, which adheres quite well to the wound. Other powders, like iodoform or any of its substitutes, do not stay in place at all, but are washed away by the watery secretion of the wound. With open treatment surgical wounds of the septum do not usually suppurate, and practically never ulcerate. The healing, especially if the wound is not even, is apt to be delayed, however, by the formation of crusts. As long as no infection has occurred these wounds are painless. When they become inflamed, dull pain is sometimes referred to the teeth, or described as a diffuse headache. Slight fever may be observed in such instances for a few days, but the wound, as a rule, does not show the infection by any altered appearance except slight swelling of its edges. Occasionally infection leads to tonsillitis on the same side, which may later on pass to the other tonsil.

**124.** As a substitute for bloody operations electrolysis of cartilaginous ledges has been recommended by various writers. Two needles connected with insulated conducting cords are inserted into the septum prominence, and an electric current up to the strength of about 25 milliampères is gradually turned on. This current, requiring a battery of 20 to 30 cells, is continued for five to ten minutes, and then is again gradually turned off. Any sudden increase or diminution in the strength of the current causes a very painful shock. As the negative pole is the active one, the positive pole may be used in the form of a large external sponge instead of a needle in the septum. This procedure has no influence upon bony crests, but it does cause a gradual shrinkage of cartilaginous prominences. If the effect is insufficient, it may be used repeatedly at intervals of about two weeks. It is, however, painful, and the inflammatory reaction fol-

lowing it always lasts several weeks, and sometimes leads to localized necrosis of the cartilage with perforation. Moreover, it is not always efficient. Its indication is hence to be restricted to the case of flat, diffuse tumefactions in very narrow noses in which surgical instruments cannot be used satisfactorily. It is certainly not a desirable substitute for any other feasible operation.

The galvanocaustic burner can be recommended as a more satisfactory measure for the reduction of smaller prominences on the cartilaginous septum. It is not a substitute for a clean cutting operation when the latter is mechanically feasible. But narrow crests which encroach sensibly upon the caliber because they happen to be situated on the convex side of a moderately bent septum can be completely removed by a number of multiple punctures or a few linear incisions with a knife-shaped white-hot burner. The wounds heal in two to three weeks without unpleasant reaction, and the cicatrization causes enough shrinkage to clear the passage.

## CHAPTER XVII.

### EPISTAXIS—HYDRORRHOEA NASALIS.

#### EPISTAXIS—NOSEBLEED.

**125.** Bleeding from the nose may depend on various intranasal lesions or different systemic disturbances. As a matter of convenient reference it is well to summarize these different conditions under one head. The loss of blood from the nose may vary from a mere trifle to a flow alarming by its persistence. Yet there are probably no immediate fatal results on record, as the hemorrhage usually stops in the end by reason of fainting. The frequent recurrence of bleeding may, however, cause serious anemia and lessen the resisting power to other diseases.

The most common lesion causing nosebleed is ulceration of the septum in the anterior inferior region immediately behind the pyriform aperture, the ulceration being the intermediate stage between anterior dry rhinitis and perforating ulcer (¶ 75). If the health is otherwise good, the bleeding from this lesion is generally not copious. When the bleeding spot can be seen, the hemorrhage can be checked by cauterization with a bead of nitrate of silver or a cotton pledget containing (melted) trichloracetic acid. The galvanocautery presents no advantage over chemical cauterization. Either measure may fail for the time being and packing may prove necessary.

A comparatively rare lesion, but one which bleeds freely, is the "bleeding polypus of the septum" (¶ 237). Its site is above the usual location of the septum ulcer. It appears as a small, red polypoid tumor, bleeding freely on touch. If well accessible, it should be snared radically, otherwise its base should be completely cut through with the galvanocaustic burner.

Very copious bleeding can be caused by intranasal tumors which are partly made up of cavernous tissue. This applies to benign polypi, suspicious adenomatous tumors, as well as to malignant cancers. Excessive hemorrhage may also be due to an unmixed angiomatous growth. Postnasal fibromata are likewise very prone to bleed freely, more, however, into the pharynx than through the nose. Slight nosebleed occurs to some extent in children with enlarged pharyngeal tonsil.

Transient bleeding may be caused by a blow, usually without lasting lesion. Any nasal operation may be followed by secondary bleeding within the first few days. Sudden diminution of air pressure in ascending high mountains starts bleeding from the nose in many persons.

Nosebleed with or without visible septal lesion may depend on various systemic conditions. After typhoid fever, in the course of grave anemia, but especially in any form of pernicious anemia, as well as in leukocythemia, it may prove difficult to manage. In scurvy and hemophilia it is more likely trivial if spontaneous, but if traumatic in a bleeder, it gives cause for anxiety. Nosebleed is an early symptom in typhoid fever, less so in measles and scarlatina, in which latter case it is said to be indicative of severe infection.

In middle or advanced life epistaxis may indicate arteriosclerosis and thus prove a forerunner of cerebral softening. The nosebleed referable to the climacteric period in women is probably also dependent on some change in the blood-vessels. Hemorrhage from the nose, vicarious for suppressed menstruation, is occasionally observed, but its frequency has been exaggerated.

If epistaxis occurs with symptoms of nasal inflammation, fibrinous rhinitis or nasal diphtheria should be thought of.

**126.** In any ordinary case of nosebleed the patient should be instructed to sit up, or, better still, stand up, in order to lower the blood pressure and to plug the nostrils

with cotton. Wiping and other useless meddling merely protracts the bleeding. The popular practice of placing anything cold (for instance, a key) on the nape of the neck probably causes reflex action of the vasomotor nerves and is not without some utility. Severe bleeding requires surgical plugging with gauze (or cotton in case of emergency). Slight bleeding is easily controlled by the use of suprarenal solution on cotton. But there has not been enough experience with this agent to state definitely whether it can be relied upon in grave cases and whether it checks hemorrhage permanently. Pledgets wet with antipyrin solution (10 per cent.) often act quicker than mere mechanical plugging, especially if the pledgets are dusted with tannin powder. The latter alone, however, is not of much use. In dangerous cases Monsell's solution of iron is certain in its action, but very disagreeable by reason of the firm clot which it produces. Whenever the blood flows into the pharynx in spite of nasal plugging, a tampon must be placed in the nasopharynx by means of Belloc's sound (or by aid of a rubber drainage-tube pushed through the nose) (¶ 29). In all instances the lesion causing the bleeding should be looked for as soon as practicable and treated.

**127. Nasal hydrorrhea** (or rhinorrhea), a discharge of a clear watery fluid from the nose, is a symptom of variable significance. It is most frequently seen in connection with sneezing fits in nasal irritability. This may depend in some instances on abnormal turgescence of cavernous tissue in neurotic subjects (vasomotor coryza), while in others it is due to the presence of polypi. In cases of this nature the hydrorrhea occurs as a spell of short duration. In less common instances the watery discharge lasts longer and is very profuse. Within less than an hour many handkerchiefs may be saturated. Much less common is a continuous discharge lasting day and night. Its cause can usually not be determined. A few times it has been seen in connection with disease of the fifth nerve, either neuralgia or paraly-

sis. In some instances the internal use of atropin has proved of service. In other instances the fluid dropping from the nose is cerebrospinal fluid. This diagnosis is favored by finding in it chemically a substance reducing Fehling's (copper sulphate) solution like sugar. An escape of cerebrospinal fluid may occur as the result of a fracture of the base of the skull. A few fatal cases have been reported in which a continuous flow of clear fluid from the nose accompanied atrophy of the optic nerves with pronounced contraction of the visual fields and with the presence of other cerebral symptoms (headache and vertigo). The autopsies showed a perforation of the roof of the sphenoid sinus due to tumors of the hypophysis cerebri or other basal tumors or hydrocephalus.

## CHAPTER XVIII.

### ANATOMY OF THE TONSILS. ACUTE INFLAMMATION OF THE PHARYNX AND OF THE TONSILS (ANGINA).

**128. Anatomy of the Adenoid Tissue and Tonsils.**—The shape and topographic anatomy of the pharynx have been described in Chap. I., ¶ 6, and Chap. III., ¶ 24, the structure of its lining membrane in Chap. I., ¶ 7. For a study of the diseases of this region some further details concerning the adenoid tissue are necessary. The entire mucous membrane of the pharynx is normally infiltrated with lymphoid cells, but a special localized development of lymphoid tissue surrounds the anterior entrances into the pharynx in the form of a "lymphatic ring," as termed by Waldeyer. This is constituted by the two faucial tonsils, the bridge of adenoid tissue stretched across the base of the tongue (the lingual tonsil), and the pharyngeal tonsil at the roof of the pharynx. Under morbid circumstances lymphatic tissue may also develop in visible masses in the form of follicles on the posterior wall of the pharynx, and especially in the form of the (hypertrophied) lateral cords of the pharynx.

The faucial tonsils form a slightly prominent cushion in the space bounded by the anterior and posterior pillars. The pillars themselves are projecting folds of mucous membrane, practically the downward prolongation of the free border of the soft palate extending down to the tongue. Above each tonsil and underneath the superior junction of the two pillars is a recess, sometimes a deep pocket—the supratonsillar sinus. The tonsil itself is a thickening of the mucous membrane due to the develop-

ment of lymph-follicles within a delicate capsule (Fig. 72). The tonsil is marked by about one dozen pits lined by mucous membrane (and pavement epithelium)—the lacunæ or crypts. Any distinct prominence of the tonsillar tissue must be considered a morbid enlargement.

Across the base of the tongue there extends a bridge of lymphoid tissue—the lingual tonsil. Besides the diffuse development of lymph-follicles, this area presents a trans-

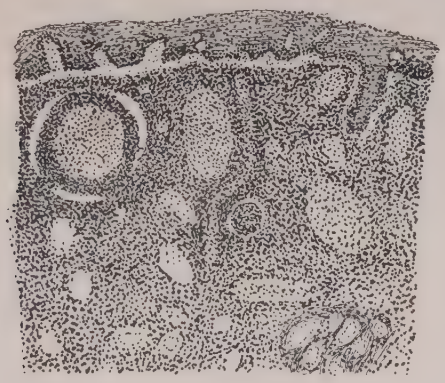


FIG. 72.—Histologic structure of the hypertrophied faucial tonsil. Soft (cellular) form of childhood. The normal pavement epithelium is penetrated by leukocytes to such an extent normally that the appearance of stratification is partly effaced. The epithelium sends offshoots into the underlying adenoid tissue. The lymphatic structure does not differ essentially from a normal specimen. The blood-vessels are larger and more numerous than in the normal tonsil.

verse row of larger lymphatic nodules, each from 1 to 4 mm. wide, containing a central crypt.

The pharyngeal tonsil consists of a cushion of mucous membrane thickened by the development of follicles so as to project in the form of shallow sagittal ridges, six or seven in number, which coalesce in front and behind. It begins at the roof of the pharynx, about 5 mm. behind the upper rim of the choanæ, and has a length of about 2 cm. Transversely it does not extend into the fossæ of Rosenmüller. The recess between the central ridges is sometimes developed into a deeper pit, the pharyngeal bursa. This is not always present. Like in

the faucial tonsil, the mucous membrane dips into shallow pockets termed crypts. The epithelium covering the pharyngeal tonsil is ciliated cylindric, while that over the faucial and lingual tonsils is stratified pavement, the same as throughout the lower pharynx.

The adenoid tissue of all the tonsils consists of minute lymph-nodules surrounded by a fibrillar stroma and filled with lymph-cells.

From all the tonsillar structures there occurs normally an outpour of leukocytes, which can be seen in microscopic sections between the cells and on the surface of the epithelium, making it, indeed, difficult to define the outline of the epithelial layer. The object of this egress of wandering corpuscles is not known. In fact, it cannot be said that we know anything definite about the physiology of the tonsils. They are capable of very active absorption of minute solid particles, like pigment granules.

## ACUTE TONSILLITIS.[1]

**129. Diffuse or Catarrhal Tonsillitis—Follicular or Lacunar Tonsillitis.**—Acute tonsillitis is a common, typical infectious disease of self-limited duration. Two varieties are described—viz., the diffuse *catarrhal* or *erythematous* tonsillitis, in which the tonsil appears diffusely reddened, and the *follicular* or *lacunar* form, in which small white exudates protrude from the orifices of the crypts. There seems to be no essential difference between these two varieties, excepting the more active participation of the lining of the crypts in the follicular form. Diffuse tonsillitis without lacunar involvement is much less common than the other variety. Tonsillitis begins with chilliness, fever, headache, and diffuse pains through the muscles and general malaise and lassitude. The temperature may reach 104° F. in children, 102° to 103° in adults. The systemic disturbances cease promptly within two to three days in most instances. They are pro-

[1] Tonsillitis and all forms of pharyngeal inflammation are often termed *angina* by continental authors.

longed if the disease begins in one tonsil and then spreads to the other, while more commonly both tonsils suffer alike from the start. There are some forms of tonsillitis in which the systemic disturbance may last four or five days, on account of a bacterial infection different from that of the ordinary form of the disease. The lymph-glands of the neck are usually enlarged, sometimes tender. Occasionally splenic tumefaction is demonstrable. From the start the throat is sore, especially on swallowing, but the pain is only moderate. On inspection the tonsils are found enlarged and red. The degree of enlargement depends somewhat on the previous size of the tonsil, but even tonsils of normal size may swell enormously and sometimes recede again perfectly on recovery. In the so-called diffuse form there is uniform redness of the surface. The redness extends always beyond the pillars, in the form of collateral hyperemia. In the follicular variety the white spots protruding from the crypts give a characteristic appearance. The surface redness is not always very pronounced in this form. The small white plugs consist of detached epithelium interspersed with bacteria, especially cocci. Sometimes the follicular exudate extends in the form of separate bits of false membrane suggesting the possibility of diphtheria. There are even instances where the entire tonsil is covered by a distinct coherent membrane, in which the diagnosis of diphtheria can be excluded only by the absence of the diphtheria bacillus. The clinical course of these (less common) forms of membranous tonsillitis, although a little more severe than that of the ordinary variety, is still that of a tonsillitis, and not that of true diphtheria. The final criterion is the absence of postdiphtheritic sequels and the inability to transmit diphtheria to others.

The local appearances in tonsillitis persist a few days after the systemic disturbances are over. When the upper respiratory passages had previously been healthy, complete recovery takes place inside of a week from the beginning. In the case of a previously diseased nose or

throat the local recovery is somewhat delayed, or tonsillitis may even persist for a time in a subacute form. The membranous variety lasts a few days longer than the simple form.

**130.** In rare instances follicular tonsillitis is limited to a small part of one or both tonsils. In such cases the systemic disturbance is nearly as pronounced as in the ordinary form, but the local lesion may scarcely be felt by the patient and can easily be overlooked.

**131. Complications.**—While tonsillitis follows usually an uncomplicated course, complications and sequels are not rare. The most frequent danger is to the ear, in the form of acute suppurative otitis. In a certain proportion of cases not fully estimated numerically tonsillitis is followed by acute articular rheumatism, especially in adults. It seems as if the cause of rheumatism, not yet identified, entered through the tonsils in such instances. Much less frequently there are observed apparently pyemic accidents, metastatic phlegmons, localized inflammations, and even endocarditis. The swollen cervical glands occasionally, but rarely, suppurate.

**132. Etiology.**—Tonsillitis is most common in childhood, not rare in middle life, but not often seen after this period. In some subjects it is frequently recurrent, sometimes repeatedly in one season. These recurrences diminish after the growth of the body is completed. Chronic inflammation of the tonsils, especially when in connection with nasal suppuration, predisposes to acute attacks of tonsillitis. Occasionally the disease attacks apparently normal and not enlarged tonsils. Tonsillitis spreads so often throughout the household that the contagiousness, of some forms at least, cannot be doubted. While the disease is commonly attributed to a cold, "such an etiology can be but rarely demonstrated." The influence of exposure is, however, suggested by the preponderance of tonsillitis during periods of inclement weather. Typical tonsillitis is sometimes seen after nasal operations followed by slight local infection. Its origin from

the wound is shown by the limitation to the tonsil of the corresponding side, although the second tonsil may become involved subsequently.

The disease has been attributed to infection by the streptococcus, which is nearly always demonstrable on the surface and in the exudate. Still, as this is a frequent inhabitant of the normal mouth, its presence on the surface does not establish its rôle absolutely. Of more importance is its demonstration in the interior of (amputated) acutely inflamed tonsils (Fränkel), and in the fluid drawn from the interior of the tonsil (Lemoine). French observers have described other forms of tonsillitis dependent upon the presence of staphylococci, pneumococci, the pneumobacillus of Friedländer, and the coli bacillus, but without specifying the clinical peculiarities of these forms. It must be emphasized that the diphtheria bacillus can give rise to a simple tonsillitis in rare instances which does not differ in appearance from the non-diphtheritic form.

**133.** While inspection establishes at once the pathologic **diagnosis** of tonsillitis, the etiologic significance of an inflamed tonsil may deserve serious attention for the purpose of a differential diagnosis. In the first place diphtheria must be thought of. A non-membranous tonsillitis is rarely of diphtheritic origin, but still such a suspicion is justified especially when exposure to diphtheria has occurred. The systemic disturbances of diphtheritic tonsillitis without membrane-formation are usually not so pronounced as in the ordinary non-diphtheritic form. But a positive diagnosis can be made only by finding the diphtheria bacillus microscopically or in culture. A membranous tonsillitis, on the other hand, may or may not be of diphtheritic origin. The more acute the onset, the less likely is the diphtheritic nature, but here, too, the decision is given only by the presence of the specific bacillus. Scarlet fever may begin as a typical tonsillitis before the rash comes out, or may continue as such even without rash. It should be suspected

when there is a diffuse deep redness of the soft palate and uvula, and when vomiting occurs. Syphilis, too, produces occasionally a typical picture of follicular tonsillitis, but the clinical course is different in this case. The disease is not of sudden onset, does not produce the intense systemic involvement, and lasts many days unchanged, but accompanied by a low fever.

**134.** Under the head of **treatment** text-books present a formidable and suspiciously long array of drugs for both internal and local use in acute tonsillitis, and each author lauds his own method. An unbiased discoverer can draw one inference only from the comparison of different text-books. We possess at present no method of treatment which can shorten the typical course of any infectious disease, except the so-called specific medication —viz., the artificial employment in an intensified form of those means by which the organism rids itself of the disease during natural recovery. Such, for instance, is the treatment of diphtheria by antitoxic serum. There is neither any logical reason nor any definite experience to warrant the belief that we can abort an attack of tonsillitis. All claims to this effect are based either on the want of recognition of the self-limitation of the disease, or on the confusion of acute tonsillitis with subacute aggravations of chronic pharyngeal trouble. We can minister only to the comfort of the patient, and by combating the liability to complications, obtain the shortest possible course of tonsillitis. The febrile discomfort may be lessened by the use of alcoholic drinks. Headache and bone-ache can be allayed by antipyrin. Sleep may be enforced by chloral or even morphin if the patient's condition demands it. Any gargle which tends to check secondary decomposition in the mouth is agreeable and apparently useful, even though it does not reach the tonsillar surface to any extent. The writer has been pleased with the clinical effects of a combination which certainly lessens the odor of the breath and adds to the patient's local comfort. It is :

| | |
|---|---|
| Thymol | 1 |
| Ol. gaultheriæ | 0.5 |
| Ol. cassiæ | 0.5 |
| Chloroform | 5 |
| Alcohol | 25 |

To be mixed with one quart of water (or two teaspoons to the glass of water) for gargling.

It must be used at very short intervals in order to obtain any lasting effect. Chlorate of potassium in saturated solution has enjoyed much popularity as a gargle, but on doubtful grounds. The dangerously poisonous nature of the drug, which has caused many deaths, should curtail its use, especially in children. There is not much more to be gained by using any so-called antiseptic sprays. The liability to persistence of tonsillitis in a subacute form after the acute symptoms have subsided can be effectually checked by various topical applications, such as nitrate of silver (10 to 15 per cent.) or tincture of iron. The writer has seen the best effects, however, from the use of Löffler's solution (compare ¶ 25).

Much can be done to guard against the habitual recurrence of tonsillitis. Our action must depend upon the previous history of the patient. Enlarged tonsils liable to become inflamed should be abscised. Smaller, irregularly shaped, but chronically inflamed tonsils which cannot be removed satisfactorily may be rendered harmless by cauterization with the galvanic burner. A pointed burner bent like a hook should be introduced into every visible crypt, whereby the crypts become obliterated (compare ¶ 151).

**135. Acute inflammation of the lingual tonsil** is a rare occurrence which manifests itself by the same systemic disturbance as ordinary tonsillitis. The pain is rather more acute, especially during swallowing, and is referred to the base of the tongue. On searching with the mirror the lingual tonsil is found swollen, red, and often marked with specks of lacunar exudation. Whatever has been said of the course of treatment of faucial tonsillitis applies equally to the present form of disease.

**136. Acute inflammation of the pharyngeal tonsil** is a subject scarcely mentioned in literature until recently, though it forms part of most cases of severe coryza. The only additional symptoms to which it gives rise, besides those directly due to the nasal inflammation, are purulent discharge in the throat and very slight soreness on swallowing. Collateral hyperemia may extend down into the oral part of the pharynx. Postrhinoscopic inspection shows acute inflammation at the roof of the pharynx.

Acute tonsillitis of the pharyngeal tonsil may also occur in rare instances as an independent affection. The writer has seen about half a dozen instances, mostly in children. It begins like tonsillitis, but lasts usually somewhat longer, up to six or nine days. In all instances there had previously been unimpeded nasal permeability until within some hours after the fever began. The nose was more or less blocked, especially during sleep, and the voice acquired the nasal twang characteristic of enlargement of the pharyngeal tonsil. There was, however, no coryza with it, but moderate mucopurulent secretion in the throat. Pain was not mentioned. The mirror inspection, often unsatisfactory in children, showed redness in the upper part of the pharynx, while the finger could detect a swelling and some tenderness of the pharyngeal tonsil. In all instances the pharyngeal tonsil regained its normal size, and, after recovery, perfect nasal respiration became reestablished. In some of the later instances the writer made applications of Löffler's solution during the latter part of the disease, apparently with beneficial results. The intense irritation due to Löffler's solution did not last long. No complications were observed.

## ACUTE PHARYNGITIS.

**137.** Acute diffuse inflammation of the entire pharyngeal lining is not so common a disease as tonsillitis. It occurs mostly in children. It begins like tonsillitis and

has about the same duration, sometimes lasting a few days longer. There is rather more pain on swallowing than in tonsillitis. There is, besides, some mucopurulent secretion coming from the roof of the pharynx. The entire pharyngeal lining appears diffusely red. Occasionally a few white lacunar specks are seen in the center of follicles on the posterior wall. Such follicles, however, had existed before the disease. In many instances pharyngitis is combined with tonsillitis. Pure pharyngitis has not the liability to recurrence characteristic of inflammation of the tonsil. Its course, causes, complications, and treatment are the same as in tonsillitis.

**138.** A rare occurrence which the patient is apt to consider as an acute inflammation in the throat is *edema of the uvula*. It begins suddenly, with some soreness, usually without recognizable cause, and gives rise to a feeling of foreign body, which the patient is tempted to swallow. The discomfort may increase to intense anguish. On inspection the uvula is seen to be swollen, sometimes enormously, but pale and evidently edematous. In the course of hours the edema subsides. Scarification is recommended. The writer has been able to relieve the few instances seen by him by long-continued massage of the sides of the neck. Suprarenal solution might deserve a trial.

## CHAPTER XIX.

### PERITONSILLAR ABSCESS OR QUINSY.—RETRO-PHARYNGEAL ABSCESS.

**139.** Peritonsillar abscess, also known as quinsy, or deep or phlegmonous tonsillitis, begins like ordinary acute tonsillitis, with or without lacunar exudation. On the first day no distinction can be made between it and acute tonsillitis in many cases. In some, however, the systemic disturbances begin with less abruptness than in simple tonsillitis. The fever may decline within a day or two, but does not disappear until the abscess opens. The local discomfort increases steadily. After one or two days the patient has a constant feeling of fulness in the throat, with a sense of oppression, embarrassing the breathing subjectively. This distress interferes with sleep. There may or may not be visible dyspnea. The moderate pain becomes intense upon swallowing and prevents eating. Characteristic is an enormous secretion of clear mucus in the pharynx. The voice is peculiarly "thick" and somewhat nasal, but not so "dead" as in blockage of the nasopharynx. The tonsillar swelling shows on the outside of the neck. The cervical glands are usually palpable.

Quinsy is more often one-sided than bilateral. On inspection the reddened and enlarged tonsil is seen projecting toward the middle line or even beyond. There is distinct swelling in front of the anterior pillar and in the soft palate above the tonsil. After the lapse of five to nine days a spontaneous perforation occurs, usually through the soft palate, about 1 cm. above and inward from the tonsil. The symptoms now subside, and within half to one day complete relief is obtained. About three days later the disease is ended.

Quinsy, much less common than tonsillitis, may occur at any age, but least often in childhood. It is clearly a pyogenic infection, evidently entering through the tonsil. It is doubtful whether it ever occurs except in subjects with some tonsillar hypertrophy. Its determining conditions are unknown. Recurrences in subsequent years are not uncommon. The exact seat of the abscess has not been determined by autopsies. It is not within the tissue of the tonsil, but external to it.

Notwithstanding the severity of its symptoms quinsy is scarcely ever followed by complications, even on the part of the ear. In enfeebled, decrepit subjects the abscess may extend and perforate into the external meatus of the ear. Under such circumstances death may occur from pyemia or septicemia, especially on extension into the mediastinal space.

The rational **treatment** is the evacuation of the pus. No other measures give any relief, but until distinct pointing of the abscess is visible the surgeon can never be sure of striking the pus. Yet the attempt must be made even with the chances against its success. The surface can be anesthetized by the prolonged application of a pledget wet with cocain solution (20 per cent.). Sometimes a blunt probe thrust into the supratonsillar fossa will reach the abscess. If this fails, a knife may be thrust into the most prominent part of the soft palate, directed outward and backward. The anatomy of the large vessels must be remembered, but they would only be endangered by carelessness or unnecessarily deep incisions. Incisions through the tonsils generally fail to reach the pus. If the operator does not succeed, he may try again daily until the pus can escape. No further treatment is required. After recovery a painstaking abscission of the tonsil should be made, to guard against future recurrences of peritonsillitis.

**140. Phlegmonous inflammation underneath the lingual tonsil** has been reported by several observers, evidently a rare occurrence. In connection with the

systemic effects of pyogenic infection a painful swelling develops in the region of the lingual tonsil, with intense distress. The choking feeling is so intense that tracheotomy has been found necessary in rare instances. Relief is at once obtained upon spontaneous escape of the pus or incision.

**141. Retropharyngeal Abscess.**—Purulent exudation or infiltration into the loose areolar tissue behind the pharynx is a disease moderately common in infancy and early childhood, but quite infrequent in later life. There are two forms, different in significance and in treatment. The **acute** abscess is a pyogenic infection of self-limited duration, and serious only by its possible sequels, while the **chronic** or cold abscess is the consequence of and indicates tuberculosis of the cervical vertebræ.

The acute abscess, it is claimed, starts from infection of the retropharyngeal lymph-glands situated between the pharynx and the spinal column. Some suppurative process in the nose or upper pharynx, idiopathic or part of an eruptive fever, furnishes the virus. The retropharyngeal inflammation begins sometimes suddenly with acute fever; more often it is of gradual onset. When the abscess is situated above the level of the palate, it interferes with nasal respiration in the same manner as swelling of the pharyngeal tonsil. When located lower, it may not block nasal breathing, but it produces dyspnea, especially intense if low enough to press against the larynx. The lower the swelling, the greater is the obstacle to swallowing and the pain produced thereby. Stiffness of the neck is common and due to muscular rigidity. After the lapse of four to eight days spontaneous perforation occurs, which usually results in recovery. In debilitated infants the infection may spread into the posterior mediastinal space and cause fatal septicemia. Pneumonia, perhaps due to aspiration of escaping pus, has also been observed.

The abscess can be seen as a more or less circumscribed

swelling on the posterior wall of the pharynx, usually one-sided, and hence asymmetric. Only in exceptional instances does the diagnosis require palpation of the space above the palate by the finger.

The **treatment** consists in an incision. In most instances this can be done satisfactorily by cutting into the swelling on the posterior pharyngeal wall with a knife with a short blade. Surgeons of a former generation used the finger-nail. Too small an opening may have to be reopened. In extensive retropharyngeal phlegmons some surgeons practise an opening from the outside behind the sternomastoid muscle, of course, under general anesthesia.

**142.** The *tubercular* retropharyngeal abscess is of slow development and indefinite duration. It is not certain whether it is ever due to tuberculosis of the retropharyngeal lymph-glands without disease of the vertebræ. In its symptoms it resembles the acute abscess, but lacks the acuity of the latter. A large exudate may ultimately break spontaneously, sometimes with recovery, more often, however, ending in secondary infection. The ultimate prognosis depends on the course of the vertebral disease. The most successful treatment is aspiration through a thick needle and injection of iodoform glycerin emulsion. This should be repeated as soon as the abscess refills.

## CHAPTER XX.

### CHRONIC PHARYNGITIS.—CHRONIC TONSILLITIS (PHARYNGOMYCOSIS) (SUPPURATIVE PHARYNGITIS).

**143.** The description of chronic pharyngitis is beset with difficulties on account of the variety of clinical pictures which this disease may present in different subjects. There is much confusion both in the nomenclature and classification given by text-books. Some present the subject under a number of subheads, giving the impression of separate disease types, which in reality do not conform with actual experience. Practically, chronic pharyngitis must be considered as an extension of, or the pharyngeal equivalent of, chronic rhinitis. As a rule, it is associated with simple, hypertrophic, or purulent nasal inflammation. Occasionally it is observed without coexisting nasal disease, because the latter has ended in recovery. In such instances the lesions are limited to the faucial or lingual tonsil. As in hypertrophic rhinitis, we must distinguish between the inflammation of the lining membrane and its hypertrophy. Either lesion may exist alone, especially in the case of the tonsils, but, as a rule, both are combined. Morbid appearances may be limited to the tonsillar surface or other small areas, or may be diffuse, extending throughout the entire pharynx. The intensity of the visible inflammation also varies considerably in different instances.

**144.** *Chronic tonsillitis* shows itself by a redness of the tonsillar surface extending always over the anterior pillars. The amount of tonsillar swelling is very variable. The tonsils may be nearly of normal size or enormously hypertrophied. Mere hypertrophy, however, although the sequel of inflammation, is not active inflammation, and an enlarged tonsil may be perfectly pale

and present no evidence of irritation. Tonsils in a state of chronic inflammation often present a very ragged appearance.

Inflamed tonsils frequently show characteristic whitish-yellow specks or plugs retained in the crypts. Sometimes these specks are visible on inspection; in other instances they must be sought with the probe. After attaining a certain size (3 to 5 mm.) they usually pop out spontaneously. They are of very offensive odor, of which the patient sometimes complains, and their presence may taint the breath. They consist of masses of bacilli, apparently a pure culture of an unidentified species. Small hard concretions of phosphate of lime are found in the tonsil in rare instances. Not so uncommon are yellowish submucous spots, minute abscesses in tonsillar follicles, without any tendency to extension.

**145.** The *lingual tonsil* is often the seat of persistent inflammation, but only after the period of adolescence. It appears reddened and swollen, and the individual nodules are sometimes much enlarged, resembling a cauliflower growth. There may be a continuous bridge of hypertrophied adenoid tissue from one tonsil to the other across the base of the tongue.

**146.** In chronic pharyngitis *enlarged follicles* of lymphatic tissue are often seen on the posterior wall in the form of red prominences of the size of a pea. This appearance has been termed *granular pharyngitis*, but all forms of transition occur between this and other varieties.

**147.** A very striking and usually very annoying form of hypertrophied adenoid tissue may occur in the form of folds of mucous membrane on the lateral wall of the pharynx back of the posterior pillars. In extreme cases they appear as vertical reddish, wing-shaped ledges, projecting from the sides of the pharynx and receding toward the roof.

**148.** *Chronic inflammation* of the *pharyngeal mucous membrane* is not always accompanied by much redness. The surface may appear of normal color, but when the

membrane is thrown into folds during the act of gagging, its thickening is apparent. Intense vascularity of the posterior wall associated with great irritability is sometimes seen in patients with nasal stenosis or nasal suppuration. The most pronounced instances are found only in habitual smokers and drinkers, scarcely ever in women. In this, as well as in other forms of chronic pharyngitis, dilated veins may be observed. Varicose veins, too, are sometimes seen on the tongue, in the region of the lingual tonsil. Even circumscribed varices of the size of a pin-head may be found. These are at times the source of bleeding, which may raise a wrong suspicion of pulmonary disease. In chronic pharyngitis the uvula is occasionally elongated. There has been too much importance attached to this by various writers. It has been claimed that the elongated uvula touches the tongue while the mouth is closed and causes mechanical irritation. This is true only in extreme instances. In moderate elongation of the uvula nothing is gained by its amputation.

**149.** The complaints in chronic pharyngitis are as variable as the clinical appearances. They depend somewhat on the individual, as well as on the character of the lesions. Often there are no subjective annoyances. Many patients, especially men, are annoyed most by the viscid mucous secretion dropping into the throat. This is due to the coexisting retronasal catarrh which usually complicates the different manifestations of pharyngitis. It is, hence, really a concomitant symptom of nasal origin. Viscid mucous secretion is also produced in the region of the pharyngeal tonsil, but neither on the surface of the lower part of the pharynx nor by the mucous lining over the faucial tonsils. Some mucus, however, may be secreted in the region of the lingual tonsil, and the presence of this gives rise to hawking and clearing of the throat.

The voice suffers commonly in consequence of pharyngitis. There is, at least, quick fatigue on attempting to

sing. Moreover, the larynx becomes involved so frequently in slight chronic inflammation in consequence of pharyngitis that the singing ability may be considerably impaired. The vocal cords are very often found permanently congested. Still, noticeable exceptions may be observed.

Chronic pharyngitis by itself produces no pain. There are, however, frequent subacute exacerbations of inflammation lasting a few days, during which there may be more or less soreness. Apart from these subacute attacks, patients complain frequently of an uncomfortable tired, irritated, "raw" feeling. Considerable tickling may be felt, especially when the lingual tonsil is involved. A very distressing feature in chronic pharyngitis are occasionally sensations of psychic origin. There is sometimes a distinct pain started during a subacute exacerbation, or in consequence of traumatism,—for instance, on swallowing a fish-bone,—and this pain will apparently persist after its original cause has ceased. In others the sensation is described as an irritation or oppression rather than as a pain. The most striking example of these sensations of psychic origin is the *globus hystericus*—a feeling of a lump rising in the throat and threatening choking. The subjects of these fictitious sensations are not always hysteric patients: they may be persons with normal nervous system, but of emotional and self-observing disposition. These fictitious sensations probably always have a material origin at the start, but are kept up by undue attention even after the lesion producing them has long been healed. They cannot be influenced by any form of treatment except suggestion. Sensible people may be cured by being assured of the harmlessness of these fictitious sensations. Undue attention given by overanxious physicians may prove a serious obstacle to their cure.

**150.** The various lesions of chronic pharyngitis give rise at times to distressing reflexes. The most common of these is cough. This may be due to a concomitant bronchitis or laryngitis, or it may depend entirely on

the sensitiveness of the inflamed areas in the upper throat, and disappear with their successful treatment. It is common in hypertrophy of the lingual tonsil. The pharyngeal irritability may lead to retching or even vomiting. This is particularly started from the inflamed lingual tonsil or the congested posterior wall. The morning vomiting of drinkers depends in part upon the pharyngeal irritability.

Chronic pharyngitis has an indefinite duration. Like chronic rhinitis, it is subject to fluctuations dependent partly on exposure to inclement weather. Subacute exacerbations are quite common. Under favorable hygienic surroundings the disease may cease to annoy the patient, but rarely disappears entirely, except upon radical change of climate.

Ear complications are very common in chronic pharyngitis, and probably depend more upon the condition of the nose than upon that of the pharynx. Such, at least, seems the conclusion based upon the results of treatment. Extension to the larynx is also very common.

**151.** The **treatment** of chronic pharyngitis must begin with a cure of the nasal condition present, even if the patient is not annoyed by his rhinitis. As long as the nasal passage remains diseased, only a very imperfect and transient improvement can be obtained by pharyngeal treatment. The removal of a nasal stenosis or suppuration, together with hygienic management, often suffices to restore the patient's comfort. Smoking and drinking must be restricted or even forbidden when the characteristic congestion of the mucous membrane indicates its harmfulness. The stomach, bowels, and cutaneous circulation must receive attention (compare ¶ 14 to ¶ 17).

Although gargling reaches the pharynx but to a very limited extent, the writer cannot but admit the utility of gargling with a sulphate of zinc solution (0.5 per cent.), as judged by its effects upon the vascularity and the irritability of the pharyngeal membrane. The use of sprays of this solution as well as of other agents has, on the whole,

proved disappointing. When there is much vascularity, considerable improvement may be obtained by brushing the inflamed surfaces of the tonsillar region or the posterior wall with Löffler's solution (¶ 25). In spite of the temporary irritation produced thereby, many patients recognize subjectively its beneficial influence. It may be continued as a daily application for several weeks. Nitrate of silver solutions (10 per cent.), formerly much in vogue, have not proven so satisfactory in the writer's experience, except when applied to the lingual tonsil. From the various other astringents recommended in textbooks the writer has seen less decided effect than from the use of Löffler's solution.

When there is much hypertrophy of adenoid tissue, surgical measures are necessary. Large tonsils should be removed. A description of the technic will be found in ¶ 182. For the cure of the offensive concretions in the tonsillar crypts slitting of these pockets has been recommended. A blunt hook is inserted and pulled through. The author has not seen as good a result from mere slitting as from obliteration of the crypts by means of a hook-shaped galvanocaustic burner. The burning, if limited to a few lacunæ at a time, causes very little inflammatory reaction. In order to attain success, the burner must be inserted into the bottom of the pocket.

When the lingual tonsil is much hypertrophied, medicinal applications are not equal to surgical removal, even though they give transient benefit. Prominent lymphatic nodules on the tongue can be snared off or destroyed with a burner. Very large prominences may be removed with a curved guillotine-shaped knife (Fig. 73).

The enlarged lymph-follicles on the posterior wall of the pharynx have formerly received more attention than they deserved. As a rule, their persistence does not interfere with comfort after the causative nasal lesions have been eliminated. When very large or persistently inflamed, the follicles may be destroyed by inserting a pointed burner into the central crypt. An awkward and

rebellious lesion is the hypertrophy of the lateral strands of adenoid tissue, the lateral cords of the pharynx. While they do not shrink much upon the application of Löffler's solution or other astringents, the irritation caused by them may subside. When prominent, they are too large to be influenced by superficial burning, while snaring is usually impossible on account of their shape. In extreme cases they may be amputated by means of cutting forceps, which, however, leaves a painful, slowly healing wound. Amputation of the elongated uvula is of much less service than would appear from the teaching of some text-books. It is useful only when the uvula exceeds a length of 2½ cm. While it can be done in a simple manner with scissors, the resulting wound is quite painful for a number of days, as the stump heals by granulation and

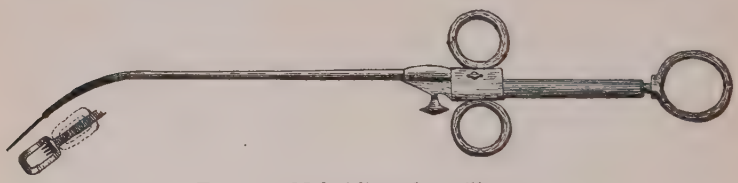


FIG. 73.—Myles' lingual tonsillotome.

moves with every motion of the palate. A few instances of disagreeable hemorrhage have been described in consequence of this operation.

**152. Pharyngomycosis** is a relatively rare disease, characterized by the presence of small white spots on the pharyngeal lining without surrounding inflammation. The spots, from the size of a pin-head to that of a grain, appear as white tufts on apparently normal mucous membrane. They are most frequently seen in crypts of the tonsils, less often on the follicles on the posterior wall or in the crypts of the lingual tonsil. There may be a few or many of these spots. The white projecting tufts are very firm and cannot be completely removed with forceps. Microscopically, they consist of interlaced, branching filaments of leptotrix, a fungus normally found in the

mouth, especially on the teeth, and usually classified, although with questionable propriety, among the bacteria. But, as Heryng has shown, the parasitic invasion is really a secondary phenomenon, while the primary lesion is proliferation and keratous degeneration of the epithelium of the crypts from unknown causes. The disease has hence also been termed hyperkeratosis lacunaris.

The disease often causes no symptoms, merely frightening the patient by the appearance. Sometimes moderate local irritation is produced by it. As a rule, it disappears spontaneously in the course of months or a few years. The spots can be removed with a certainty only by deep punctiform burns with the galvanocaustic burner. If no symptoms are produced, there is no reason for any therapeutic interference.

## SUPPURATIVE PHARYNGITIS.

**153.** Pathologic and therapeutic considerations demand that suppurative pharyngitis should be considered apart from the other forms of pharyngeal inflammation, although it may be associated with hypertrophic lesions. The only pharyngeal area from which pus is secreted is the region of the pharyngeal tonsil at the roof of the pharynx. Purulent secretion is not observed clinically from any other part of the pharyngeal lining. The presence of pus in the lower pharynx does not establish the diagnosis of suppurative pharyngitis, as the secretion originates much oftener from within the nose than from the pharyngeal roof. The diagnosis can be made only by seeing the pus at the vault of the pharynx in the mirror. Even in the latter case the pus may come from the sphenoid sinus or posterior ethmoid cells. Suppurative pharyngitis is, besides, often associated with some form of purulent rhinitis.

Purulent secretion may be found in connection with moderate hypertrophy of the pharyngeal tonsil in children. Although of a chronic nature, there may be complete

intermissions in the course of this form of suppurative pharyngitis during mild weather. When the enlarged pharyngeal tonsil persists after puberty, it undergoes a sclerotic change, and is then much less likely to form pus. Hence in adults suppurative pharyngitis is more commonly observed without enlargement of the pharyngeal tonsil. In the class of cases mentioned the secretion is that of thick, yellowish green, but fluid pus. In another variety of the disease the secretion is more scant and dries in the form of adherent crusts dislodged with some difficulty. The surface underneath is found reddened and often slightly excoriated; rarely, thickened. This variety of disease, not very common in general, is extremely rare in childhood. It resembles ozena in the character of the secretion. The comparison is also borne out by the spaciousness of the pharynx often observed. The mucous membrane may even present an atrophic appearance, as judged by the naked eye. But the specific odor of ozena is lacking except when this form of pharyngitis is combined with true nasal ozena.

The complaints refer, in the first place, to the secretion. It is especially when dry crusts form that patients are irritated by their presence and make forcible efforts to dislodge them, sometimes finishing by retching. The crusts seem to form only once in from one to three days. Their presence may cause reflex symptoms, such as coughing and headache referred to the occipital region.

**154.** Pharyngeal suppuration is usually due to a diffuse inflammation of the mucous membrane in the area of the pharyngeal tonsil. When the tonsil is enlarged enough to be prominent, there is no method of permanently arresting the process, except by the operative removal of the adenoid tissue. But as seen in adults without thickening of the pharyngeal lymphatic tissue, the suppuration may be stopped by other means. Quite often the persistent removal of the secretion by the post-nasal douche will lead to a cure in the course of some weeks. An atomizer with curved pharyngeal tip may

prove equally efficient if properly used. When these means do not suffice, the writer has succeeded at times, but not invariably, by brushing the pharyngeal vault with nitrate of silver solutions (20 to 30 per cent.) or Löffler's solution. Due care must be used not to spread these irritant fluids over the adjacent surface, for which purpose the palate may be held by means of a broad retractor. When the pharyngeal disease accompanies purulent rhinitis or suppuration of a sinus, the nasal lesion must be cured before the pharyngitis will yield to treatment.

**155.** A peculiar pathologic basis has been claimed by Tornwaldt for many cases of suppurative pharyngitis, especially those in which crusts are observed. He attributes the disease to an inflammation localized in the pharyngeal bursa, which, he claims, is a deep persisting recess of embryologic significance. Neither his anatomic notions nor his clinical data have received full confirmation by other observers. The bursa is not a constant, and rarely a deep, sinus, and others who have sought for this localized inflammation have not found it so typical a disease as Tornwaldt asserted. It must be admitted, however, that the clefts, and especially the central cleft between the ridges of the pharyngeal tonsil, may be the seat of a persistent suppuration, and that occasionally types of pharyngeal disease are found which correspond to Tornwaldt's description. Tornwaldt claims to have cured his patients by cauterization of the diseased recess with a bead of nitrate of silver or by the insertion of the galvanocaustic burner. In those cases where pus can be seen to issue from clefts in the pharyngeal tonsil, I have occasionally found this mode of treatment successful.

**156.** A lesion not rarely found in the pharyngeal tonsil are **cysts** with purulent contents, the result of suppuration confined to a lymph-follicle. They may be of the size of a pea or larger, and produce symptoms of pharyngeal irritation. They are removed by abscission of the tonsil (¶ 174).

**157.** A form of pharyngeal disturbance formerly described as "**pharyngitis sicca,**" or "atrophic pharyngitis," must be mentioned, although it is not a real pharyngitis. The mucous membrane looks pale, dry, apparently atrophic, and is covered with a varnish-like clear secretion dried on the surface. The appearance results from purulent rhinitis or sinuitis, and with the cure of the nasal suppuration the pharyngeal lining recovers its normal condition.

## CHAPTER XXI.

### HYPERTROPHY OF THE PHARYNGEAL TONSIL OR ADENOID VEGETATIONS.

**158.** The frequent occurrence of hypertrophic lymphatic tissue at the vault of the pharynx had been entirely overlooked until W. Meyer described this important condition in 1869. Yet it is a very frequent and very noticeable disturbance. In various school examinations it has been found to exist in from 5 to 9 per cent. of all children. No race and no country seem to be exempt. Its existence since historic times has been made probable by Meyer by finding the characteristic facial expression indicative of it in various portraits from the middle ages and even in some statues of antiquity.

The direct consequence of enlargement of the pharyngeal tonsil is obstruction of nasal breathing to an extent proportionate to the space occupied by the new growth—and hence inversely proportionate to the dimensions of the pharynx. On account of the vascularity of the lymphatic tissue its size is subject to fluctuations. While a moderate enlargement may be inappreciable during erect posture, the increased blood supply during the reclining posture may entirely prevent nasal breathing. The obstruction is also increased during sleep by the accompanying turgescence of the posterior ends of the turbinals. Still more noticeable is the obstruction when an acute coryza increases the congestion. The patient hence sleeps with the mouth open, and snores whenever he lies on his back, although while awake he may be able to breathe through his nose (except in high degrees of hypertrophy). When there is secretion, which often occurs in this trouble, the child cannot blow his nose,

but draws the pus back into the pharynx. Enlargement of the pharyngeal tonsil also betrays itself by its influence on the voice, which becomes "dead" and loses its resonance. The nasal sounds "m" and "n" are especially interfered with; the former ("m") sounding like "b," the latter ("n") like "d." An excellent description of the speech in high degrees of adenoid vegetation is given by Dickens in his character Barney, in *Oliver Twist.* It is only in complete obstruction of the nose by a severe coryza or polypi that the same mode of speech is heard.

**159.** The interference with nasal breathing results in the course of time in thickening of the lips and sinking in of the sides of the nostrils. These peculiarities, together with the open mouth, give these children a very characteristic "stupid" expression, accentuated by a "dreamy" look due to vascular fulness of the lower eyelid, whereby the lid-space is reduced in aperture. In well-marked instances the expression, as well as the voice, suggests a positive diagnosis. The characteristic appearance has been termed the "adenoid habitus." In many cases the obstruction of the nasopharyngeal space is accompanied by changes in the shape of the hard palate, which at first becomes merely arched to an abnormal degree. After the second dentition, however, its form often changes to a V-shaped or Gothic arch, while the lateral teeth, especially cuspids and bicuspids, may incline inward instead of pointing straight downward. The changes in the palate and alveolar process are, however, not absolutely characteristic of enlarged pharyngeal tonsil. Children with enlarged pharyngeal tonsils are very prone to "take cold." They get fresh nasal catarrh from slight exposure, and it often remains chronic during the inclement season or even longer. Purulent secretion, however, when present, is always due to a complicating inflammation of the nose or of the pharyngeal tonsil itself—often very persistent, but it is not a symptom resulting from mere

hypertrophy of this structure. In typical instances it may be entirely absent. In the less pronounced forms of hypertrophy of the pharyngeal tonsil there is often the copious mucopurulent discharge described in ¶ 35 as the "scrofulous" form of purulent rhinitis.

If the adenoid vegetations are not removed, a hypertrophic condition of the turbinals, especially the posterior ends, as well as septal overgrowth, are very often found in older children. Hypertrophy of the pharyngeal tonsil is often accompanied by enlargement of the faucial tonsils. They are generally deep seated between the pharyngeal pillars, and hence do not apparently project far into the mouth as compared with their actual size.

**160.** The ears suffer in a large proportion of cases of adenoid vegetations. The most common condition is that of catarrh limited to the Eustachian tube, which form gives the least unfavorable prognosis. More serious are attacks of purulent inflammation. Serous catarrh of the middle ear is not common in younger children, but not so rare in the period preceding and following puberty. As a rule, the ears are involved in consequence of some transient acute or subacute inflammation, and not merely on account of the mechanical presence of the enlarged tonsil. The tonsillar hypertrophy, however, is the important determining condition, without which the temporary coryza or pharyngitis would scarcely endanger the ear. While the ear affections yield to the usual local treatment, relapses are almost sure to occur unless the hypertrophied tonsil is removed. Hence with neglect the hearing may become permanently damaged.

A common complaint of children with adenoid vegetation is cough. Generally this is due to frequent and often persistent attacks of bronchitis following acute nasopharyngeal inflammation. In other instances it seems to be a reflex disturbance without lesions in the lower respiratory passages.

**161.** Children with marked pharyngeal obstruction not merely look stupid, but often are so. They find it

difficult to concentrate their attention. This mental sluggishness has been termed *aprosexia*. Headaches—referred to the back of the head—are not uncommon during inflammatory exacerbations. Asthenopic complaints,—difficulty in the use of the eyes,—fatigue, and strain are sometimes complained of. I have seen a fair number of instances in which low degrees of far-sightedness or astigmatism annoyed the children sufficiently to necessitate glasses, which could be discarded after the pharyngeal operation—which, of course, does not change the structure of the eye itself. The interference with nasal respiration disturbs sleep. Such children are often restless at night, toss about or wake with nightmare or frightening dreams. Nocturnal incontinence of urine is also not uncommon. Groenbeck observed it 26 times in 198 cases. In about one-half of the instances this annoyance ceases at once after the operation. In most of the others it improves gradually. The cervical lymph-glands are frequently enlarged. How large a proportion of such indurated glands is tubercular has not been determined. In high degrees of pharyngeal obstruction the children may present a stunted growth and marked insufficiency of weight. The dependence of this impaired nutrition upon the blockage of the pharyngeal space is often shown by the satisfactory increase in the rate of growth following operation.

**162.** Attention has also been directed, especially by earlier French surgeons (Dupuytren, Chassaignac) to deformities of the chest observed in children having large tonsils. It is partly a constriction of the lower part of the chest as compared with the dimension of the upper part, partly a flattening of the thorax in the lateral diameter, with undue prominence of the sternum—the so-called pigeon-breast. Whether these conditions are not dependent on the coexistence of rickets is perhaps an open question. Undoubtedly, however, the interference with breathing and the resulting violent exertion of the diaphragm, together with undue pressure of the

external air upon the yielding infantile thorax during inspiration, account for the occurrence of these deformities. The respiratory obstacle is, however, not so much due to the enlarged faucial tonsils, as was formerly believed, as to the blockage of the pharynx by the adenoid vegetations, which the earlier observers had not recognized. Among my patients in this country, where rickets is not a frequent disease, I have seen but little of these chest deformities, and never in a very pronounced degree. Although most of the disturbances due to enlargement of pharyngeal tonsil are of mechanical origin and are hence pronounced in proportion to the degree of enlargement or its relative bulk compared with the (variable) size of the pharynx, still at times even very moderate growths will give rise to much interference with nutrition (Harrison Allen). I have sometimes seen improvement in the general health of children that seemed out of proportion to the small amount of adenoid tissue shown by the operative removal.

The pernicious influence of adenoid vegetations upon the blood (anemia) shows itself by a poverty in red globules and hemoglobin, with absolute increase of mononuclear and eosinophile leukocytes and lymphocytes, while after the operation there is a gradual return to the normal condition of the blood (Lichtwitz and Sabrazès).

**163.** While the enlargement of the pharyngeal tonsil is an affection of childhood, it does not necessarily disappear at puberty. Sometimes the respiratory obstacle, with all its resulting disturbances, lasts during middle life. As a rule, however, the pharyngeal space grows during the second decade of life at a faster rate than its adenoid tissue, and the latter often undergoes partial involution. This is evident by the rotundity which the surface of the enlarged gland presents in adults, compared with the coxcomb-shaped irregularities of the surface in earlier childhood. Hence, after adolescence the mechanical interference with breathing subsides somewhat as a rule. Yet secondary hypertrophic changes in the nasal

walls and Eustachian tubes, and hence liability to frequent inflammatory attacks of nose, ears, or bronchial tubes, are apt to persist after adolescence as the sequel of juvenile adenoids.

**164.** The **diagnosis** of enlarged pharyngeal tonsils can be made with much certainty in more pronounced cases on noting the facial expression and the characteristic speech. If inspection shows no obstruction in the nose itself, the cause of the respiratory interference must be in the upper pharynx. With the exception of rare cases of excessive enlargement of the posterior ends of the turbinal, or the still rarer occurrence of fibroid tumors in the pharynx, the lesion will be found to be enlargement of the pharyngeal tonsil. The diagnosis is confirmed by examination with the finger. The surgeon presses the cheek between the teeth, so as to keep the mouth open and prevent the child from biting, and thereupon inserts the finger through the mouth into the upper pharynx by sliding in behind the palate, and observes the resistance met with in feeling for the upper rim of the nasal passage. In normal instances the relatively resisting posterior wall and roof are recognizable by touch, and the space will be found clear. When the adenoid tissue is enlarged, a soft cushion can be felt lining the pharynx and encroaching upon its caliber. As a rule, too, the finger gets bloody. The surgeon may be misled as to the amount of adenoid hypertrophy in case the body of the first cervical vertebra is exceptionally prominent in the pharynx.

The digital examination is very disagreeable to the patient. In the case of tolerant children a mirror examination may be attempted instead of palpation. Impracticable under the fourth year, it is quite feasible in many older children, especially after they have passed the seventh year. A partial view may also be obtained by direct inspection on retracting the palate with a hook and throwing the head back to the utmost extent. In younger children the surface of the enlarged gland is

irregular. There are coxcomb-shaped ridges running anteroposteriorly, usually six in number, sometimes more by reason of branching or less by coalescence of the ridges. Most of the illustrations in text-books showing tufts and cauliflower-shaped projections are fanciful and do not correspond to what is actually seen. As puberty is approached the involution of the adenoid tissue smoothens the surface and the growth is more likely to appear as a semiglobular cushion relatively hard. The pharyngeal tonsil is to be considered pathologically large whenever its outlines are recognizable as an elevation above the level of the surface, since when perfectly normal, the edge of the adenoid area slopes so gradually as to be distinguishable from the rest of the mucous surface

*a* *b* *c*

FIG. 74.—Enlarged pharyngeal tonsils removed in one piece by the author's adenotome (actual size): *a*, From a child four years old; *b*, from a child eight years old; *c*, from a young man twenty years of age.

only by its slightly darker tint and ridged and furrowed surface. Normally there appears a clear space of a few millimeters between the front end of the adenoid cushion and the upper rim of the choanæ. The more the tonsil is enlarged, the more does it project over the upper rim of the bony frame of the nose, while in pronounced cases it covers the entire posterior choanæ in the postrhinoscopic image. The enlarged gland can sometimes be seen by direct inspection on retracting the palate forcibly with a hook, while the head is thrown backward.

**165.** The *structure* of the enlarged pharyngeal tonsil is that of the normal gland with all its elements uniformly increased. In earlier childhood the tissue is soft, due to

a preponderance of lymph-cells. As involution progresses the growth becomes harder, as felt by the knife in cutting it. This depends on the gradual increase of the fibrillar elements, with corresponding reduction in the number of lymph-cells. Not uncommonly some of the follicles undergo suppuration and change into miniature abscesses. The size of the growth may in extreme cases amount to about 6 to 8 c.cm., attaining the bulk of a walnut. Its attachment is always central, and does not extend laterally into the fossæ of Rosenmüller (Fig. 74).

**166. Etiology.**—Enlargement of the pharyngeal tonsil is the consequence of acute coryza in childhood. Whenever a continuous observation is possible, it can be learned that the respiratory interference begins with an attack of coryza, and persists after the nasal inflammation has ceased. Successive inflammatory attacks gradually lead to the full morbid development of the adenoid tissue. This usually begins during the first years of life, rarely, if ever, after the third, but may continue to increase during subsequent attacks of rhinitis until the period before puberty. The possibility of adenoid hypertrophy depends on a predisposition, the nature of which is not understood. It is often a family trait, conspicuously present in some families, markedly absent in others. It is favored by small dimensions of the nose and pharynx, but is strikingly absent in the spacious passages of subjects suffering from ozena.

There has been some confusion created by descriptions correlating adenoid vegetations with scrofula. It is now admitted that the term scrofula is often used in a vague, not well-defined, sense. Some of the characteristics formerly referred to scrofulosis are the direct consequence of hypertrophy of the pharyngeal tonsil—viz., the thick lips, the attacks of subacute purulent rhinitis, and the liability to purulent otitis. All this may occur in children in whom no other evidences of scrofula are present, and hence the diagnosis scrofula may be incorrectly made, merely on account of the presence of adenoid vegetations.

On the other hand, the pharyngeal hypertrophy is often associated with true scrofula, as shown by the presence of palpable tubercular lymph-glands.

**167.** It has been claimed that there is some relationship between adenoid vegetations and tuberculosis. The most positive assertion is attributed to Koch by Trautmann, to the effect that children with this disease react to diagnostic tuberculin injection. No one else besides Koch (and Petruschky) has made this test on a sufficiently large scale. In the writer's experience of more than twenty years a large number of subjects with adenoid vegetations during childhood have not presented any evidence of tuberculosis during many subsequent years of observation.

Various recent researches have shown that about 5 per cent. of enlarged pharyngeal tonsils contain tubercles with tubercle bacilli. These tonsils differ in no wise from the appearance of non-tubercular hypertrophies. The tubercular disease is and remains entirely latent. The diagnosis can be made only by the subsequent microscopic examination, which shows the presence of typical tubercles scattered throughout the adenoid tissue. In most cases the tubercular infection is a secondary occurrence, as shown by the existence of tubercular foci in other parts of the body. Indeed, it has been found that in tuberculous cadavers even the not enlarged normal pharyngeal tonsil may be the seat of miliary tubercles. It is to-day an open question whether a primary tuberculosis of the pharyngeal gland does occur at all. Yet while the disease follows a latent course without leading to further changes in the adenoid tissue, the subsequent tubercular infection of the lymph-glands may help to spread the mischief. All these statements concerning the occurrence—presumably secondary—of latent tuberculosis and its numerical frequency apply to the faucial tonsils to the same extent as to the pharyngeal tonsil. The results of operations are just as satisfactory in the case of tonsils subsequently found to be tubercular, as

when we deal with simple enlargement without tuberculosis.

**168. Treatment.**—Every enlarged pharyngeal tonsil which causes any symptoms whatsoever should be removed by operation. It is only when the enlargement is discovered accidentally and has hitherto caused no manifestations that the question of operation may be left for a future time. The operation may be said to be free from risk. There are about half a dozen cases of fatal bleeding on record, either in bleeders or in poorly nourished subjects, not watched sufficiently after the operation. In the case of a bleeder operated by myself, an annoying hemorrhage persisted for thirty-six hours without leading to bad results. The hemorrhage is always profuse momentarily, amounting in exceptional cases up to 50 to 100 cm., but rarely persists long. Its persistence is generally due to shreds incompletely detached, and may be stopped by removing these shreds. Plugging of the postnasal space is very rarely required.

Beyond a slight fever, apt to occur within the next twenty-four hours, it is quite uncommon to see any annoyance from the operation. Soreness is never pronounced, often absent. The wound heals in about a week, during which period there is sometimes some suppurative discharge. There is no after-treatment required or of any service.

**169.** Abscission of the hypertrophied pharyngeal tonsil removes promptly all the symptoms caused mechanically by its presence, while the remote consequences disappear gradually. Even an incomplete removal may give temporarily very satisfactory results. The less thorough the operation and the younger the child, the greater the liability to subsequent growth; hence apparent relapses are sometimes observed which may necessitate a second operation. A complete removal precludes relapses. In cases complicated, however, by intranasal anomalies, stenosis, purulent rhinitis, or sinus affections the benefit

of the operation may be masked by the persisting nasal disease.

**170.** It has been much debated whether the operation should be done with or without narcosis. The writer's experience has led him to condemn narcosis as unnecessary in most instances. Hinkel has collected 18 deaths from American and English sources alone from 1892 to 1898 from operations on the pharyngeal tonsil done under narcosis. This is an appalling mortality in an operation otherwise devoid of risk. Hinkel suggests that the development of the adenoid tissue coexists often with persistence of the fetal state of the thymus gland, the condition termed status lymphaticus—which predisposes to sudden death from trivial causes. Bromid of ethyl has been lauded as a convenient substitute for chloroform or ether for this operation, on account of its quick and transient anesthesia. But statistics have shown that for other purposes this agent is not safer than other anesthetics.

Narcosis makes the operation more formidable and necessitates more assistance. It does not in any way permit a more thorough operation, as most of the relapses which the writer has seen had been operated previously by others, or by himself under anesthesia. The pain in well-arranged operations is not sufficient to necessitate the superfluous risk of an anesthetic. It is only in the case of unruly children from whom active resistance must be expected that narcosis becomes necessary. Narcosis is also preferable when the faucial tonsils are to be excised at the same sitting, as this triple operation is usually too severe a tax on a child's tolerance. With narcosis the head must be pendant over the edge of the table, or the body turned to one side. With this precaution there is no risk of blood entering the lower air-passages.

Without the narcosis the child is firmly held in the lap with its body tilted forward and the head thrown back, as this position is the most favorable. The pain is very

much reduced by the use of a cotton pledget moistened with 20 per cent. solution of cocain, held in place for some two to three minutes. It has seemed to the writer that cocain anesthesia is enhanced by the previous use of suprarenal solution, as well as the hemorrhage somewhat reduced, but some pain must be expected.

**171.** The easiest, quickest, and most thorough mode of operation is by means of the curved guillotine devised by Schütz. The writer had been experimenting along the same line, and devised a similar instrument with a more favorable form of handle (Fig. 75). The pharyn-

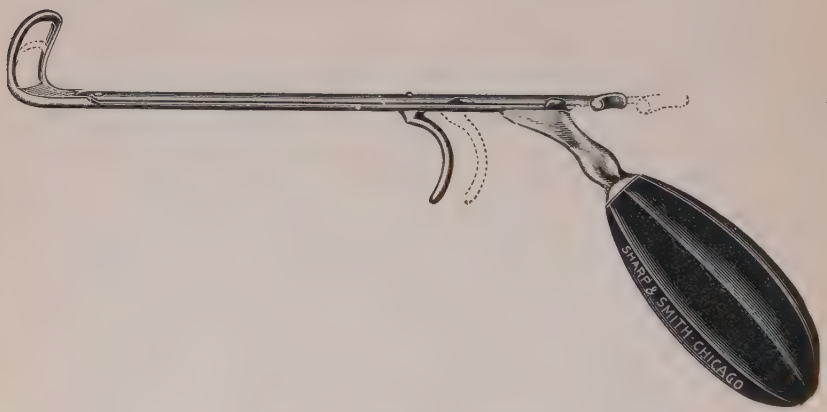



FIG. 75.—Author's adenotome.

geal end of the guillotine is 20 mm. wide, the sweep of the knife about 22 mm. in length, and the curve is adapted to hug the entire roof and upper posterior pharyngeal wall. The instrument is slid up behind the palate, pushed upward and backward with considerable force, and in one sweep the knife removes the entire adenoid growth. By inadvertence this may be swallowed without harm. By extensive comparative trials the writer has found no other mode of operation so thorough, so quick, so painless, and followed by so little hemorrhage as by means of this instrument. The ordinary size of the instrument will fit any child over three to four

years of age. A smaller size can also be had. Large faucial tonsils are no real obstacle to its introduction.

**172.** A very popular instrument is the Gottstein knife, which should be well sharpened (Fig. 76). It is intended to slide in place along the posterior edge of the vomer,

FIG. 76.—Gottstein's adenoid knife.

whereupon it is forcibly pushed backward and downward. Soft adenoids are easily removed in one sweep. But in case of harder structures of older children, the knife is more apt to slip than the guarded blade of a guillotine. It may have to be inserted repeatedly until the finger finds the space clear.

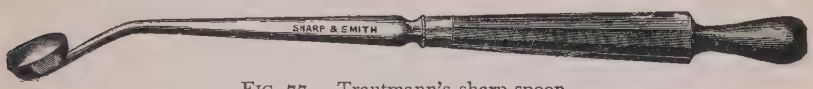



FIG. 77.—Trautmann's sharp spoon.

The Trautmann sharp spoons or curets (Fig. 77), made in three sizes, although very efficient, have been superseded by the broader Gottstein knife. They often fail to remove the entire gland, while causing considerable hemorrhage.

**173.** A postnasal cutting forceps for the adenoid opera-

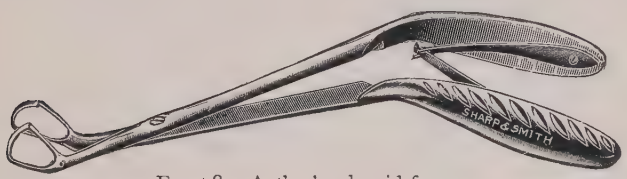



FIG. 78.—Author's adenoid forceps.

tions was originally devised by Loewenberg. As his model was too clumsy and withal its blade too small, the writer constructed a forceps of sufficient size to grasp the entire tonsil (Fig. 78). The upturned part is 17 mm. high, and the curved cutting blade extending

through the arc of a circle has a total length of 15 mm. Yet it will rarely remove the entire gland in one piece, although three or four successive cuts can clear the space very perfectly. The lateral spring-guards originally intended to prevent the pieces from falling into the larynx have been found unnecessary. In my former experience I found it advantageous to supplement the work of this form of forceps by the subsequent introduction of another forceps cutting transversely, so as to reach the extreme lateral end of the growth (Fig. 79).

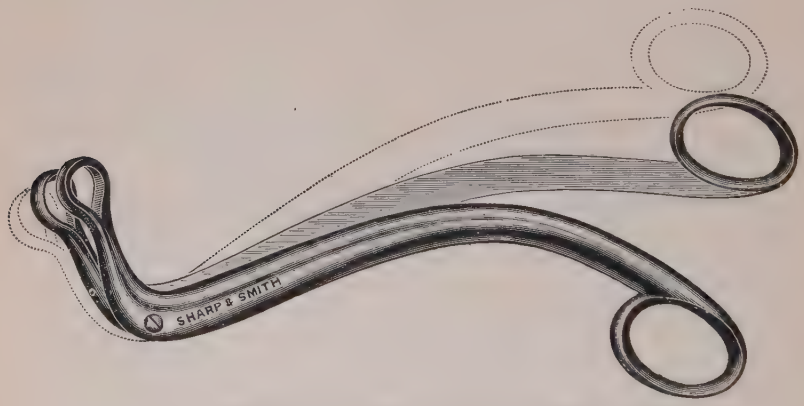



FIG. 79.—Adenoid forceps cutting in the anteroposterior direction.

**174.** Some surgeons use the cold snare through the mouth either with a straight or a slightly curved cannula. This causes relatively little bleeding, but must be reapplied quite often, in order to remove the entire tonsil. At the best, it is an uncertain and tedious mode of operating, although not very painful. The writer can recommend it only for small remnants left by previous incomplete operations, especially in older subjects who can tolerate the pharyngeal mirror.

The snare put through the nose is even more uncertain in its action and very disagreeable. The operation was done originally by Meyer by means of a ring-shaped curet put through the nose vertically and then turned horizontally. This method has been entirely abandoned.

The so-called simple method of scratching off the vegetations by means of the finger-nail is still occasionally mentioned by writers. It is thoroughly unsurgical and entirely inefficient when the tonsil is of firm structure. The use of a sharp steel shield over the end of the finger—the artificial nail—can likewise not compete with the use of properly designed instruments.

**175.** In any form of operation except by means of the curved guillotine used with sufficient pressure there is a possibility that some fragments may be left. If these are of any size, a recurrence of the growth is possible in younger children. Partially detached shreds may cause a persistent hemorrhage. Unless examination of the excised tonsil or its fragments gives assurance that the operation has been thoroughly done, the pharynx should be explored by the thoroughly sterilized finger. It is, however, difficult to recognize small remnants of the gland immediately after the operation. During the following five to seven days any remaining bits of adenoid tissue are swollen by reason of traumatic inflammation, and bleed freely when disturbed. If any remnants of the tonsil are detected after the lapse of a week, they should be removed by the use of cutting forceps or the cold snare.

No medicinal treatment has any influence upon an enlarged pharyngeal tonsil. Cauterization—chemical or thermic—is inefficient and dangerous to the ear.

## CHAPTER XXII.

### HYPERTROPHY OF THE FAUCIAL TONSILS.

**176.** Enlargement of the faucial tonsils is even more common than excessive growth of the pharyngeal tonsil. It begins in early childhood, rarely later than about the tenth year of life, and remains unchanged during subsequent development. The protrusion of the enlarged tonsil is either inward or outward. In the former case the tonsil protrudes into the fauces as a more or less globular body. In the latter case the adenoid cushion spreads out, but remains more or less hidden between the pillars, and finds room for its overgrowth by crowding the tissues outward and somewhat upward. In extreme instances of this type the tonsil may scarcely protrude while the palatal muscles are at rest. But its large size is shown by corresponding prominence during the act of gagging. Most commonly the tonsil grows both inward and outward. The projection of the hypertrophied tonsil may be very unequal on the two sides, but when an outward growth occurs, it involves usually the two tonsils to a symmetric extent. The enlarged tonsil, when not inflamed, is pale. The orifices of its crypts are very distinct. Large tonsils are, however, often in a state of chronic inflammation, especially during childhood, and present a redness which extends over the adjoining part of the palate and anterior pillar.

**177.** Hypertrophy does not change the typical *structure* of the tonsil. All its constituent elements are uniformly involved. During the earlier period the enlarged tonsil is soft and quite vascular. Upon the application of cocain such a tonsil shrinks very decidedly in size. Later on many enlarged tonsils undergo a fibrous change and become harder, with a predominance of the

connective tissue and stroma over the lymphoid cells. Although these harder tonsils are less vascular, the fibrillar sclerosis involving the arterial walls may lead to troublesome hemorrhage during operations on account of imperfect retraction of the vessels.

**178.** The morbid enlargement of the faucial tonsils is produced by the same causes which lead to hypertrophy of the pharyngeal tonsil—viz., repeated attacks of coryza during early childhood. Hence enlargement of the faucial tonsils is often, though not invariably, associated with enlargement of the pharyngeal tonsil. On the other hand, it is rare to find adenoid vegetations without at least some overgrowth of the faucial tonsils. Large tonsils are often found without any history of previous throat inflammations. But the occurrence of tonsillitis is an additional factor often leading to further growth. Nasal stenosis of any kind seems also a potent etiologic factor.

A small proportion of enlarged tonsils contains tubercles without any characteristic or distinctive appearance during life. This latent tuberculosis does not reveal itself in any way except by the induration of the cervical lymph-glands, which is not characteristic. The statements made in ¶ 167 concerning tuberculosis of the pharyngeal tonsil apply equally to the faucial tonsils. Here, too, tubercular infection is mostly, if not always, secondary to some other focus of the disease somewhere else in the body. Infection results most likely from tubercular sputum, but may perhaps be primary in some cases from the use of tubercular milk.

**179.** Enlarged tonsils, when not inflamed, need not cause any **symptoms** or disturbances. This is especially true of tonsils which have grown into the faucial space, and which many a patient retains to old age without suffering therefrom. Those glands, however, which, by their growth, have pushed the tissues outward and upward and are concealed between the pillars, may produce mischief by their mechanical presence. They may cause

engorgement of the posterior ends of the turbinals sufficiently to necessitate mouth-breathing with accompanying restlessness during sleep. They may simulate the presence of an enlarged pharyngeal tonsil. Yet in the majority of cases, when symptoms of mechanical origin are referred to the faucial tonsils, they are really caused by the coexisting enlargement of the pharyngeal tonsil. More potent for mischief are large tonsils in a state of chronic inflammation, when distinctly and permanently reddened. In this condition they may constitute the essential lesion of so-called chronic pharyngitis and account for all the symptoms present—viz., uncomfortable sensations, throat irritation, and cough. Persistently reddened tonsils are often subject to periodic attacks of acute or subacute inflammation. The history of many patients teaches that recurrences of acute tonsillitis are common until the tonsils are removed. Chronically inflamed tonsils may also help to maintain chronic disease of the Eustachian tube, even though they represent but one of the factors involved. It is current belief, though not definitely proven, that large tonsils increase the liability to and the danger of diphtheria and scarlet fever.

**180. Treatment.**—The description of the disturbances produced by enlarged tonsils indicates what may be gained by their operative removal. Tonsils that have caused no symptoms may be let alone, but whenever any constant or periodic disturbance can be referred to their presence, the tonsil should be removed as thoroughly as possible. Abscission of a superficial slice is of very little value. The operation is practically free from serious risk. Perhaps a few dozen cases of fatal hemorrhage are on record in bleeders or from neglect. Annoying hemorrhage is not uncommon, especially in adults with hard tonsils; less so, in children. Primary hemorrhage may be avoided by the use of the hot snare. But even in this case a secondary hemorrhage, though very rare, is possible after detachment of the eschar. There are no large bleeding

vessels, but free oozing may occur, especially in hard tonsils, and is sometimes difficult to control. Gargling with tannic or gallic acid as recommended in text-books does not check it. Pellets of ice are sometimes of benefit. More positive is a tampon steeped in antipyrin solution (10 per cent.), dusted with tannin, and held firmly in place. A tampon wet with Monsell's solution of iron is equally effective, but forms a disagreeable, voluminous clot. Steady compression by means of a plain tampon held by forceps will often suffice. Patience is a necessary virtue. Various clamps have been devised to be left in place for hours. In very rare extreme cases it has been found necessary to tie the external carotid artery.

**181.** Tonsillar wounds become covered with a whitish-gray coating which may resemble diphtheria. Superficial infection is probably inevitable in every case, but it is not common to see any deeper or more serious evidence of infection. Even when such unpleasant reaction does occur, it causes only transient annoyance and no real danger. Tonsillotome wounds heal in from five to ten days, according to their size. It is not possible to maintain a tonsillar wound aseptic. The nearest approach to it the writer has found in the free and repeated insufflation of glutol, which, however, adheres but incompletely. Iodoform does not adhere at all. So-called antiseptic mouth-washes (compare ¶ 134) add to the patient's comfort during the healing and control the odor of the breath, but do not influence the wound to any extent. Tonsillar wounds always pain more or less, but this pain can be entirely controlled by the insufflation of orthoform a few times a day.

Tonsil operations require anesthesia only when active resistance on the part of the patient is to be expected. The pain is considerably reduced, but not entirely avoided, by free brushing with 20 per cent. solution of cocain.

**182.** The simplest mode of operating is by means of the guillotine, of which there are various patterns (Fig.

80). In all of them a gliding spear drags the tonsil inward while the knife cuts. The guillotine must be forcibly pressed against the pillars in order to grasp enough of the tonsil. This operation is efficient when a globular mass projects into the faucial space, but it is

FIG. 80.—Mathieu's tonsillotome.

insufficient when dealing with a broad, flattened tonsil hidden between the pillars. When remnants are left after the use of the tonsillotome, they may be seized with forceps and snipped off with long scissors or a blunt-pointed bistoury. Indeed, it is not difficult to amputate a projecting tonsil simply by the use of the bistoury and

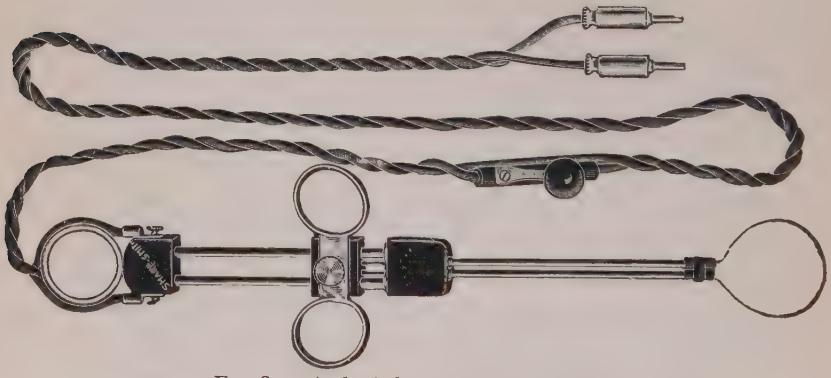


FIG. 81.—Author's hot snare for tonsillotomy.

traction forceps, but the operation cannot be done as quickly as with a tonsillotome.

**183.** In the case of hard fibrous tonsils in which hemorrhage is feared (especially in adults), or when the shape of the gland does not permit complete removal by the tonsillotome, the hot snare can be used to advantage. As most of the galvanocaustic snares in the market are too

fragile, the writer has designed a stronger instrument for the removal of the tonsil (Fig. 81). The tonsil is seized with a double hook or a vulsella forceps, over which the snare is slipped until it grasps the tonsil as near as possible to its base. The wire is drawn tight while cold, and heated to a bright-red glow only when resistance is felt to its further constriction. The resulting wound heals nearly as quickly as a cut with a knife. No bleeding whatsoever occurs. If necessary, the snare may be reapplied until no projecting remnants are left. When the shape of the tonsil does not permit the snare to be applied, the adhesions of the adenoid tissue to the pillars may first be separated by the use of a hook or a blunt-pointed knife. The grasp of the snare may then be facilitated by burning a shallow groove into part of the periphery of the tonsil with a

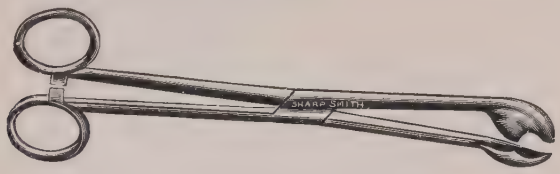



FIG. 82.—Ingals' tonsil forceps.

galvanocaustic burner. The wire loop can now be easily slipped into this groove. Special grasping forceps are sometimes useful (Fig. 82).

The cold snare is a less cumbersome instrument than the galvanocaustic snare. It is slightly more painful, however, and unless a strong instrument is used, the wire may not cut through, but pull out of the instrument, causing embarrassment. A strong and apparently efficient snare has been devised by Peters (Fig. 83). The cold snare does not prevent hemorrhage with so much certainty as the hot wire. Some surgeons have suggested dissecting out the entire tonsil by means of a galvanocaustic knife-shaped burner. This is an uncalled-for mutilation, leaves a large painful wound, often resulting in irritating scars, and may give rise to serious secondary hemorrhage.

**184.** It is often a serious question how to deal with large, deep-seated, and not projecting tonsils which cannot be reached well by any instrument. In the case of very young children, discretion is sometimes the better part of valor. Inasmuch as such tonsils do not ordinarily cause any serious damage and usually shrink somewhat in the course of time, it is at times the wiser plan to let them alone. If an operation is, however, clearly indicated, it can be made more thorough by removing the deeper portion of the tonsil piecemeal with any kind of punch-forceps—for instance, my postnasal forceps (Fig. 79).

Considerable reduction in the size of tonsils may be

FIG. 83.—Peters' tonsil snare.

obtained by inserting a pointed burner into the crypts and obliterating them gradually. The result is ultimate shrinkage. If only a few crypts are burned at one sitting, there is but very little inflammatory reaction. Yet the result in the end is never so satisfactory as that of a clean amputation if the latter is feasible or accepted by the patient.

Hypertrophied tonsils cannot be reduced in size by medicinal treatment. The swelling due to chronic inflammation, however, may be influenced somewhat by the use of Löffler's solution. Its employment for some weeks will sometimes render an operation unnecessary. A marked

influence upon the size of chronically inflamed tonsils is also exerted by the removal of the hypertrophied pharyngeal tonsil. Faucial tonsils which seem to indicate operation will often become quiescent and harmless after the successful removal of adenoid vegetations.

## CHAPTER XXIII.

### HAY FEVER—AUTUMNAL CATARRH.

**185.** Hay fever is an affection characterized by severe nasal irritation, usually extending to neighboring organs and occurring only during a part of the warm season, but recurring annually. It may be compared to a severe coryza vasomotoria produced by certain unknown conditions existing only during the summer. The attack begins with itching of the nose, which extends to the eyes and often the ears. The nose soon becomes obstructed, a part of the time wholly occluded. Periodic sneezing fits occur, followed by profuse watery discharge. The nasal symptoms, as well as the complaints referable to adjoining organs, fluctuate during different times of the day and on different days. They are usually made worse by hot, dry weather, moderated by rains and cooler spells. A high degree of nasal occlusion causes a feeling of pressure in the head, sometimes headache. The eyes become suffused with tears, blood-shot, and the lids show venous congestion, which may finally give them a dusky hue. The ears often become stuffy, but no permanent ear lesions are produced by hay fever. The throat feels irritated, and more or less severe coughing may follow. The most distressing symptom is difficult breathing, which increases to periodic spells of asthma, especially at night.

On examination the nose presents no appearances characteristic of this disease except edema of the mucous membrane, especially over the turbinals during the height of the attack. The nasal lining is not injected except when previously in a condition of hypertrophic rhinitis. There is, however, excessive turgescence of all cavernous tissue. The surface is very sensitive to contact of the

probe. Mechanical irritation intensifies the attack and starts the secretion. The discharge in typical cases is a clear serum. Occasionally, but rarely, the disease is combined with a true inflammatory coryza with purulent discharge. Whatever other lesions or anomalies may be found are not due to hay fever, but existed previously and constitute a favorable predisposing condition for this disease. It is quite common to meet with septum deformities, sharp lateral crests, and circumscribed hypertrophies of the mucous membrane or enlargement of the pharyngeal tonsil, but all preexisting before the attack came on.

After hay fever has ceased with the end of the warm season, the patient has no further nasal symptoms except those due to any existing lesions and anomalies independent of hay fever. The disease returns annually, with an occasional exception. After many seasons it sometimes stops spontaneously, especially on permanent change of residence to a more favorable locality. Most patients, however, do not lose their annual affliction. In our climate typical cases begin toward the end of July or middle of August, and often on the same day each succeeding year. The affection stops at the latest with the first frost, in some people indeed with the beginning of cooler weather. In less typical instances it may start earlier in the season, even in June, or whenever the weather gets warm. In these cases it is likely to fluctuate considerably with the weather, or even to intermit temporarily. The less typical cases present all gradations from genuine hay fever limited to the summer months to irregular spells of vasomotor coryza brought on by various other modes of irritation, as well as by warm weather. This atypical form is known as "rose-cold." In England and on the Continent hay fever begins and ends earlier than in America. The disease seems most prevalent among the English and Americans. It has scarcely been observed in the north and south of Europe. But reports are multiplying concerning its occurrence in

Germany and France. The same statement really applies to our country as well, and it is an open question whether the disease is on the increase, or whether physicians give it more attention than formerly.

**186.** The disease ceases within a few hours, or at the latest within a day, on going to certain localities known to be immune against hay fever. Some parts of the White Mountains, especially the village of Bethlehem, and the open sea afford relief to all sufferers. Many other localities give immunity to most patients, but not to all. Strange to say, some people may suffer in one place and find relief in the other, while to others this boon is reversed. These favored spots are the larger lakes, the upper Michigan shore of Lake Michigan, most of the shore of Lake Superior, the woods of Northern Michigan, and many of the higher localities in the Rocky Mountains. The peculiar seasonal and geographic distribution of hay fever has led to the view that it is produced by the inhalation of the pollen of grasses floating in the air. In our climate the pollen of the universally distributed ragweed is especially suspected. The principal basis for this view has been furnished by the researches by Blackley, himself a sufferer from the disease. By means of a device resembling a rain gauge he collected and counted the number of pollens on microscopic slides exposed for a definite length of time. He found thus that the beginning of the attack coincided with a certain increase in the number of particles floating in the air, while the remissions during cooler or moist weather coincided with diminished prevalence of the pollen. As we do not know any other form of irritant the seasonal and geographic variations of which explain the etiology of hay fever, the pollen theory is at present a plausible working hypothesis. But it cannot be said to be established definitely. Blackley contracted an attack of hay fever while on the ocean by opening a package of pollen, and thus apparently showed that these vegetable particles can bring on the attack, yet this isolated case is

scarcely convincing on account of the psychic factor involved. The fact that sufferers may get the disease in cities far distant from fields is consistent with our knowledge of the wafting of dust over large distances. But there are a few instances on record of attacks persisting on seaboard on the ocean at distances over which the land dust is not carried. Perhaps the most difficult problem not answered by the pollen theory is the immunity enjoyed by small areas,—for instance, the village of Bethlehem in the White Mountains,—while neighboring regions, apparently under similar conditions, do not protect against the disease. All the favored localities are relatively dust free, but mere absence of dust does not necessarily protect.

**187.** All observers agree that some form of predisposition is necessary in order to contract the disease. It is rare in very young children, but often begins after about the tenth year. It does not often begin after the fourth decade of life, but even old age is not entirely exempt. It is more common in men than in women. It is a disease almost limited to the refined classes, and is hardly ever observed in people below a certain social status. A person who is poor and uneducated is practically proof against this disease. This peculiarity, as well as the recurrence in many on the same day of every year, points to the importance of psychic factors, the full rôle of which we cannot yet analyze. Many patients present a distinct neuropathic taint, although pronounced neurasthenia and hysteria are not markedly predisposing. While the bulk of the sufferers are otherwise in good health, anemia and convalescence from enfeebling diseases often coincide with the first attack of hay fever. Those in whom no personal nervous history can be elicited give usually evidence of nervous instability in the family history. The disease involves not rarely several members of a family. Basing himself on extensive statistic inquiry, Beard has termed hay fever a functional neurosis. If we understand by the term neurosis a

nervous disturbance not dependent upon demonstrable change in the nervous system, and not the necessary consequence of some peripheral lesion, this name is applicable. We may thus call hay fever a neurosis due to a certain irritation of the respiratory mucous membrane by an unknown irritant in predisposed subjects.

The predisposition depends partly upon the existence of other nasal anomalies. This is shown by their frequent coexistence, as well as by the beneficial influence of their elimination. The successful removal of septum deformities, of circumscribed hypertrophies of mucous membrane, and enlargement of the pharyngeal and faucial tonsils or of foci of suppuration relieves some patients markedly and occasionally cures one completely.

**188.** Hay fever victims escape the disease by spending the fatal season in an immune locality. Some stand the distress as long as possible until the increasing heat forces them to flee for relief. The sufferers have formed a hay-fever association with headquarters at Bethlehem, which, while it serves to spread useful information, exerts, on the other hand, a bad psychic influence.

Most writers speak of the valuable influence of nerve tonics, arsenic, zinc phosphid, or valerianate strychnin, etc., upon the disease, but I cannot find a single record of any permanent cure obtained thereby. The latest reports of the Hay Fever Association claim emphatically that there are no cures on record. On the other hand, more can be expected of intranasal surgery upon proper indications. The full restoration of nasal patency relieves the suffering to a great extent, even if it does not prevent the attack. In medical literature a number of apparent cures are on record, but they have mostly not been followed for a sufficient number of successive seasons to be fully convincing. I may say the same of several instances in my own limited experience with this disease. Some years ago galvanocaustic destruction of the turgescent cavernous tissue was extensively practised, apparently with some relief during the following season. But the

records of the Hay Fever Association disclaim any permanent cures obtained thereby. During the attack itself any operative treatment, except a clean incision resulting in free patency of the nose, gives rise to very unpleasant reaction.

Decided temporary relief is obtained by the use of a spray of suprarenal solution. This agent has also been recommended for internal use, but on questionable theoretic grounds and with very questionable results. In several instances in which hay fever coexisted with and seemed dependent upon purulent rhinitis I have obtained an apparent cure for the season by the use of this spray, followed by the douche, and the spray of watery solutions of the essential oils (¶ 25). The use of cocain is too transient to be serviceable, and the danger of cocain habit too great to sanction its employment by patients. The asthmatic attacks can sometimes be greatly relieved by antipyrin internally.

**189.** It is instructive to compare the pathology of hay fever with that of another disease of similar seasonal and geographic distribution—viz., spring catarrh of the conjunctiva of the eye. This affection is not directly related to hay fever. In about 15 instances of it which I have seen I have known only one patient to suffer at the same time from hay fever. Its lesions are the striking but not constant grayish tumefactions of the ocular conjunctiva around the cornea, while absolutely constant, but less noticeable, are the lesions of the conjunctiva of the upper lid. The disease begins during the warm season and ends with frost, but returns annually. Its symptoms are irritation of the eyes, watering, sensitiveness to light, and discomfort on use. The symptoms cease during the cold season at first, but in some patients persist in a very mild degree during winter after a duration of many years. The first summer the conjunctiva of the upper lid shows merely a mild degree of catarrhal inflammation with stringy mucous secretion. The second season the surface is slightly follicular. Later on the follicles en-

large and assume the appearance of papillæ. During winter the conjunctiva is again normal, but after a number of years the lesions diminish, but do not disappear entirely during cold weather, producing, however, very little annoyance. Like hay fever, spring catarrh returns with fatal regularity every year. As the writer was the first to point out, a sufferer gets absolute relief by going to a locality immune against hay fever. The resemblance to hay fever is, unfortunately, completed by the rebelliousness of the disease to all treatment.

## CHAPTER XXIV.

### DIPHTHERIA.[1]

**190.** Diphtheria may be defined clinically as an inflammation with the formation of false membranes, and etiologically as the reaction of the tissues to infection by the diphtheria bacillus. These two definitions do not coincide fully. A pseudomembranous inflammation is sometimes caused by other germs, while the reaction to the diphtheria bacillus may be limited to a superficial inflammation without membranes. Diphtheria is essentially a disease of childhood. Uncommon within the first few months of life, its maximum frequency and mortality occur in the first five to seven years of infancy, becoming less frequent and less fatal after that period. It is not frequently seen after adolescence and very rarely after middle life.

The disease begins with fever, usually increasing for a day and of variable height, rarely excessive, sometimes remittent or even absent. The fever lasts usually as long as the local lesion. With it there are marked general disturbance, lassitude, malaise, want of appetite, furred tongue, and often more or less albuminuria. The cervical glands are generally swollen, and remain so until after recovery. From the start there is pain on swallowing and sore throat. The affection begins most often on the tonsils, generally on both sides, sometimes on the posterior pharyngeal wall, rarely on the soft palate. The invaded spots show a whitish coating, in the form of a membrane, which from the start cannot be detached without leaving a bleeding abraded surface. In severe cases

[1] It is not within the province of this work to include a complete description of diphtheria, as this disease is fully treated in all text-books on general medicine. Hence details will only be given regarding its localization in the upper air-passages.

the color of the membrane may turn to a dark brown, being stained by blood extravasation. Around the membrane is an area of considerable redness and swelling. When the tonsils are involved, they swell. Except in mild or in properly treated cases the membranous inflammation extends so as to involve the larger part of the visible throat. It may spread upward into the nasopharynx, which is rare, or even into the nasal passages. Much more common is the involvement of the larynx in the form of croup. The extension may continue from two to five or seven days, rarely longer. After this period the membranes gradually detach themselves, and the abraded surfaces heal. When the membranes are detached artificially, they form again in a few hours. Occasionally a relapse or rather an exacerbation occurs when the disease seems nearly ended. In exceptional cases the persistence of the disease for a number of weeks has been observed. In rare instances deep ulceration may follow after detachment of the membrane and cause cicatricial shrinkage and adhesions in the pharynx.

**191.** The disease varies in severity with the epidemic and with the individual. We can distinguish between abortive, mild, average, and severe or septic cases, but with transitions between these forms. The systemic disturbances are more or less pronounced, somewhat in proportion to the intensity of the local process. But sequels, especially the different forms of paralysis, are nearly as apt to occur in the mildest cases as in the severe. The contagiousness, also, does not depend on the severity of the case. In abortive cases nothing is seen beyond an apparently slight pharyngitis or tonsillitis. The diagnosis suggested by known exposure can be verified only by the bacteriologic test or the subsequent occurrence of paralysis. In mild cases the typical membranes are seen, but they do not spread in extent after the first or the second day. In the severe or septic form, the severity of which depends perhaps on concomitant infection by other germs, especially streptococci, or on want of re-

sisting power of the victim, the prostration and fever reach a high degree from the start. The membranes spread rapidly and extensively and are of more than ordinary thickness, while the septic complication is shown by the intense foulness of the breath and the systemic prostration. Hemorrhages into the mucous membrane stain the membranes a dark brown. In such severe instances the disease lasts longer and is followed by a more tedious convalescence.

**192.** The **mortality** of diphtheria varies considerably in different years and with the class and age of patients. Before the antitoxin treatment was introduced the average death-rate in hospitals was from 30 to 35 per cent., this figure being much surpassed in children under five years, while adults gave a more favorable prognosis. In private practice the death-rate did not generally exceed about one-half of this figure, but fluctuated in different years. The most common cause of death is extension into the larynx, resulting in suffocation. In the second place, general sepsis due to streptococcus complication is to be feared. Bronchopneumonia carries off a large proportion, especially in hospitals. A small number die from sudden heart failure.

**193.** The recovery is **complicated** in a large percentage of cases by transient paralysis of the soft palate. This occurs about two to three weeks after the start and lasts two to three weeks, always terminating favorably. It shows itself by the passage of fluids or even solid food into the posterior choanæ during swallowing, and by the changed and diminished resonance of the voice. On inspection, the palate is seen to hang flaccid and immovable during intonation. Somewhat less common is paralysis of the ciliary muscle of the eye, with complete suspension of accommodation, but without involvement of the iris movements—always bilateral. Except in the case of myopia it causes inability to read, while hypermetropes who require their accommodation for the distance see blurred even in the distance. Like paralysis

of the palate, it always ends in spontaneous recovery in the course of two to three weeks. The percentage of these postdiphtheritic paralyses has risen since the introduction of antitoxin treatment, on account of the greater number of patients surviving under this treatment. More serious than these localized affections is the diffuse involvement of motor and sensory nerves throughout the body, of which cases a small proportion end fatally. Diphtheria of the pharynx and nose leads to suppurative otitis in a moderate proportion of cases.

**194.** The clinical description of **nasal diphtheria** as an extension from the pharynx has been given in ¶ 82. While this must be considered as a very grave complication, primary diphtheria of the nose as described in ¶ 81 is a remarkably mild disease, often entirely afebrile and rarely leading to any complications. It is, however, just as contagious as other forms.

In a small number of instances diphtheria ascends into the upper pharynx above the palate, probably always as a secondary extension from below. It may prove rather persistent in this locality, causing mild systemic disturbances, with nasal obstruction and sniffling due to postnasal secretion. When the postnasal mirror cannot be used, the diagnosis is based on obtaining fragments of membranes on exploring the region with a cotton-applicator or on the bacteriologic test.

According to postmortem findings, some of the nasal accessory cavities are commonly infected during ordinary diphtheria. The infection is due to the bacillus of diphtheria in nasal diphtheria, although even then the inflammation is not necessarily pseudomembranous. When the process has not reached the nose, the sinuses are transiently inflamed, with or without secretion, by reason of the entrance of some of the ordinary pyogenic microbes.

Recovery is followed by immunity lasting many months, and often a lifetime. Yet recurrences after the lapse of a year are sometimes met with.

**195. Pathology.**—The diphtheritic process consists of a necrosis of at least the epithelium, or even of part of the mucous membrane, to a variable depth, with inflammatory reaction in the mucous membrane underneath. The necrotic tissue still in contiguity with living tissue becomes imbued with coagulating fibrin. Its detachment by sloughing occurs subsequently after the destructive action of the microbes upon the living tissue has come to a standstill by the resisting power of the latter. Pathologists distinguish between croupous and so-called true diphtheritic inflammation. In the former case only the epithelium is involved, and a firm, easily detached membrane results. In the latter type the process is deeper seated and the necrosis affects the mucous membrane underneath the epithelium. Both forms of inflammation are caused by the same parasite, the process depending somewhat on the resisting power of the tissues and more so on the locality affected. In the larynx it is superficial croup, as a rule; in the nasal passage it may be croupous or deeper diphtheritic inflammation; in the pharynx, it is generally true diphtheritic inflammation.

**196. Etiology.**—Diphtheria is the result of infection by a specific microbe, known as the Klebs-Löffler bacillus. Its precise description and cultural peculiarities can be found in all bacteriologic works.[1] It has been found and

[1] A short straight or slightly curved bacillus, variable in size, averaging about 0.5 to 0.8 $\mu$ in length by $\frac{1}{3}$ $\mu$ width. Non-motile. Many irregular club-shaped forms mixed with typical rods. Stains fairly readily, especially with alkaline methylene-blue. Takes Gram stain. Staining shows polar differentiation, the ends being more colored than the center. Neisser's stain applied to fresh culture of diphtheria bacilli shows granules at or near the end of each rod stained blue in an isolated manner. A culture kept at 35° C. for ten to twenty hours is used. After fixation by heat the cover-slip is stained one to three seconds with—

| | |
|---|---|
| Methylene-blue (Gruebler) | 1 |
| Alcohol (96 per cent.) | 20 |
| Distilled water | 950 |
| Glacial acetic acid | 50 |

well washed in water and counterstained three to five seconds in vesuvin solution (1 : 500 boiling water). The diphtheria bacillus grows readily in most

identified by observers in diphtheria throughout the whole world. About one-fifth to one-fourth of the throat diseases which suggest the clinical diagnosis diphtheria are really due to other germs, mostly the streptococcus. In these cases the specific bacillus is, of course, not found. However much the appearances may temporarily resemble true diphtheria in these instances, the clinical course is, as a rule, not quite the same. They are milder (except in connection with scarlet fever), are less likely to extend in area, have a small or no mortality (again excepting scarlatinous angina), and are never followed by paralytic sequels. Clinically, however, it is often impossible to distinguish, at the beginning, between a membranous angina due to other germs and a mild diphtheria. The diphtheritic bacillus is also not found in true diphtheria if the examination in a septic case is made at a late period, when other coexisting parasites have crowded out

media and does not liquefy gelatin. Thrives especially well in Löffler's solid serum (3 parts blood-serum with 1 part bouillon containing 1 per cent. peptone, 1 per cent. grape-sugar, and 0.5 per cent. salt). On this serum other microbes do not grow as rapidly as the bacillus diphtheriæ, which shows, in the incubator, round, moist, grayish-white colonies within twenty-four hours, while within eight to ten hours the colonies, too small to be seen by the eye, may be examined microscopically on transferring them to a cover-slip. Grows readily in milk without changing the appearance of the fluid. Cultures and dried bacilli remain alive for long periods of time. Killed by water of 60° C. inside of half an hour, and practically instantaneously by boiling soda solution.

Much confusion has arisen from the existence of another bacillus, the pseudo-diphtheria bacillus of von Hoffmann, which resembles the true diphtheria bacillus closely in morphology and cultural peculiarities. A distinction between the two is certain only by reason of the absolute harmlessness of the pseudo-diphtheria bacterium to animals, and very probable on careful comparison of cultures in various media. According to most observers, the pseudo-diphtheria bacillus does not show the characteristic polar granules with Neisser's stain applied to young cultures.

The pseudo-diphtheria bacillus is found relatively often in the normal throat, and to some extent, too, in non-diphtheritic disease of the pharynx, but not usually in large number. On the other hand, in true diphtheria the pseudo-bacillus does not multiply, as a rule, and whenever tests on animals have been employed, it was found that all the bacilli in real diphtheria were pathogenic. Hence when a micro-organism resembling the diphtheria bacillus is found *in abundance* in any throat lesion, the diagnosis of diphtheria can be made with very little chance of error.

the specific germ. Cultural search for the diphtheria bacillus will also fail if antiseptics have previously been applied to the throat. But apart from these apparent exceptions the Klebs-Löffler bacillus is always found in genuine diphtheria, and its presence or absence decides the diagnosis. Since the successful treatment of diphtheria is absolutely specific, a bacteriologic search should be made in every case.

In stained cover-slip preparations made by wiping the membranous spot with a sterile rod the bacillus can be detected in a sufficiently characteristic form for diagnostic purposes in more than 50 per cent. In case of doubt a culture is made from the membrane by wiping it with a sterile rod, with care to prevent contamination. On the surface of the serum recommended by Löffler the diphtheria bacillus grows more readily than most bacteria likely to be found in the throat, so that its characteristic colonies can be detected with the microscope and identified after the lapse of eight to ten hours (in the incubator or any warm place of about 100° F.). A very convenient culture-dish is the flat covered tin box suggested by Jaques, its advantage being the small bulk, its protection against contamination, and its low cost.

**197.** The diphtheria bacillus has been found by culture a number of times in the normal throat of persons known to have been exposed to the disease. In the case of susceptible subjects, especially children, its presence may finally result in delayed infection. But undoubtedly many individuals, particularly those beyond early childhood, are more or less proof against the disease, and the bacillus may exist in such throats transiently as a surface parasite, harmless to the bearer, but a source of danger to others. In other instances the germ causes a superficial or very mild inflammation without the formation of membranes—the abortive cases.

**198.** In microscopic sections of the diseased pharyngeal mucous membrane the bacillus is found only in and immediately underneath the false membrane. The appear-

ances show positively that the tissue necrosis extends as deep as the bacillary invasion. By culture a few isolated germs are sometimes found in the viscera in fatal cases.

The proof that this parasite is the cause of diphtheria has been completed by the demonstration of its pathogenic power in animals, as well as by the study of the poison it produces and of the physiologic antidote formed in the animal body against this poison. Inoculation of mucous membranes in animals (especially young animals) with the isolated germ produces diphtheritic inflammation, however, without the marked tendency to extend as it does in man. But the reaction to most pathogenic germs is by no means identical in different species of animals.

The etiologic significance of the diphtheria bacillus is supported by a study of the effects of its poisons. When the culture fluid deprived of living germs is injected into animals, the characteristic prostration is obtained, ending fatally in case of a sufficiently large dose and causing a lingering cachexia in smaller quantities. In many instances characteristic paralyses follow. A fatal dose of poison is contained in a small fraction of a drop of the culture fluid. Injected under the skin, it produces inflammatory swelling and even necrosis. But the characteristic diphtheritic inflammation is not produced by any soluble poison. By the repeated injection, at intervals, of non-fatal doses of diphtheria toxin animals become immunized to enormous quantities of poison, and are likewise rendered germ-proof thereby. The immune animal has developed a remarkable new property in its blood-serum. The immune serum is an antidote against the diphtheria poison, and the intensity of this antidotal action is proportionate to the degree of immunity. The quantity of antidote which will neutralize an amount of poison representing a ten-fold fatal dose for a guinea-pig is termed an antitoxin unit. By suitable immunization of horses during the course of a number of months a serum can be obtained containing as an extreme about 500 units per cubic centimeter. The neutralization of diphtheria toxin

by immune serum takes place if the two are mixed before injection, or if either be injected a short time before the other. But if many hours are allowed to elapse between the injection of the poison and its antidote, the requisite number of antidotal units must be enormously increased. The longer the animal has been under the influence of the poison, the more antitoxin does it take to undo the effect of the poison, until the recovery of the animal becomes at last impossible. Antitoxic serum has no direct effect upon the diphtheria bacillus. It does not influence its life in any way. But by protecting the organism against the deleterious effects of the poisons which this germ generates, it enables the system to treat the diphtheria bacillus as a harmless parasite. The animal organism has the ability to rid itself of all microbic parasites which do not overwhelm the resisting power of the system.

**199.** Diphtheria, as seen clinically, is usually a mixed infection, or at least becomes so in the course of the disease. Streptococci or staphylococci, or both, as well as various other forms of microbes, are found to a variable extent associated with the diphtheria bacillus and often replace it later on. The gravity of the disease is apparently much enhanced by this mixed infection, which is more pronounced the more severe or septic the form of the disease. On the other hand, the diphtheria invasion may be secondary to some prior lesion of mucous membranes. Thus we may have a secondary diphtheria as a sequel to the sore throat of scarlet fever, measles, or syphilis. When ulcerations due to any other affection become diphtheritic in appearance, the diphtheria bacillus is, as a rule, found to be the cause. A diphtheritic appearance, however, may also be due to streptococcic infection.

**200.** Diphtheria is eminently contagious. Coughing, spitting, and even speaking disseminate through the air microscopic droplets of fluid containing the living germs. Physical considerations make it likely that this mode of

infection can spread only through a small area. There is more danger from kissing and the handling of toys and soiled utensils. Sputum dried on the handkerchief may scatter the germs as dust. According to clinical experience the dissemination of the germ through attendants and clothing does not occur to any great extent, and the greatest danger is from direct contact. It has often been claimed, but never absolutely proven, that the virus may be disseminated through milk. The danger of the diphtheria patient to others persists for at least a number of weeks, sometimes over two months, after perfect recovery; for during this period of time living virulent germs can be detected in the throat and often, too, in the nose.

The disease is most likely to become epidemic during the cold season and in crowded localities, evidently on account of the greater facilities for its dissemination. Its incubation is two to three days, but as infection does not necessarily follow at once upon introduction of the germ into the mouth, a week or even more may elapse before the disease breaks out after exposure.

**201.** Since the **treatment** of diphtheria is absolutely specific, the diagnosis should be established by bacteriologic test. But it would not be wise to wait half a day or longer until the test has been made or reported upon by some expert. Time is of the utmost importance in the use of antitoxin. It should, therefore, be injected at once upon clinical indications, and deferred only until the end of the bacteriologic test in cases when the clinical diagnosis is in doubt. The best results are obtained by injecting at once a large number of units—not less than 3000, and 4000 or more whenever the symptoms are pronounced or the case has advanced beyond the first half day. When extension threatens, the dose may be repeated several times if needed, at intervals of twelve hours. As a rule, this is not necessary. The hypodermic injection should be made with full aseptic precautions to guard against the possibility of abscesses. The antitoxic serum itself

is put up sterile and usually preserved by the addition of trikresol (0.5 per cent.).

As the result of this treatment the fever disappears in from one to three times twenty-four hours, but the symptoms of systemic disturbance cease sooner, so that the child, hitherto sick, begins to play. There is no apparent influence upon the membrane, but almost invariably further extension of the diphtheritic inflammation ceases at once. When the larynx is still intact at the time of injection, croup—formerly so much dreaded—scarcely ever appears. There is, accordingly, too, but little to fear of other sequels like bronchopneumonia.

It is difficult to state in an individual case that the recovery is due to the treatment, as the disease in favorable cases heals spontaneously in the same way. But the influence of the specific treatment upon the mortality is now universally admitted. The few voices raised against antitoxin on the part of writers not open to conviction have now practically ceased. Statistics from the entire civilized world have shown that the mortality has, on an average, been at least cut in two, while individual observations under favorable circumstances with sufficiently large dosage and early employment of antitoxin have yielded results even much more favorable. The crucial test, indicating the value of the specific treatment of diphtheria, is the mortality-rate arranged according to the date of employment of antitoxin. Within the first twenty-four hours the death-rate has been below 5 per cent., and in many small series has been nearly zero. When employed after the first day, the antitoxin has less decisive control over the disease until the influence is nearly lost, apparently, by delaying the injection until the fourth or fifth day of the disease. No other treatment in this or any other disease has been tested in this crucial manner in so many thousands of instances and with such incontrovertible results. Even though statistics do not show a reduction of the death-rate when the treatment is delayed until the fifth day, it must not

be forgotten that these delayed and hence selected cases represent a series of more than average severity, and hence ordinarily of more than average mortality. For otherwise there would be no need of beginning the injections at this late time. Deaths occurring within twelve hours after the injection simply show that the treatment was begun too late and had not had time to exert its effect.

**202.** There are no contraindications against the use of antitoxin. In about 10 per cent. of cases the injection gives rise to disagreeable, but not serious, consequences. Within one or a few days it may be followed by a rash resembling either measles or scarlet fever, but lasting only a day or two, with moderate fever, occasionally nettle-rash, and in rare instances inflammatory swelling around some joints, which subsides within a few days. The few deaths which have occurred shortly after injections were due partly to the severity of the disease, partly to other sometimes unaccountable influences, like habitus lymphaticus. It is well known that any trivial operation may sometimes be followed by immediate unaccountable death. Very few minor operations have been practised on so enormous a scale as antitoxin injections.

**203.** It is very questionable whether we possess any means of treatment to influence diphtheria except antitoxic serum. A comparison of the enormous array of drugs recommended formerly by every writer, with strong individual preferences not shared by any other writer, leaves but little doubt that the treatment was more suggested by humane intentions than by positive knowledge. None of the means of local applications have ever been tested statistically according to the day of their employment. They are all being gradually discarded. Löffler, the discoverer of the diphtheria bacillus, tested the ability of antiseptics to kill the bacillus immediately and to penetrate at the same time through thick layers of a culture. His most satisfactory results were obtained with a fluid known as the Löffler mixture—viz.:

| | |
|---|---|
| Toluol | 10 |
| Menthol | 2 |
| Tincture of chlorid of iron | 4 |
| Alcohol | up to 100. |

This has been tried on a limited scale for the local treatment of diphtheria, and while moderately praised, has not found universal recognition. It undoubtedly does penetrate deeply, killing both the diphtheria bacillus as well as other germs present as far as it reaches. But, after all, those in the depth of the false membranes escape largely. Yet, judged by clinical evidence in individual cases, its use, when brushed upon the affected spots once in four to eight hours, is not without some benefit. It certainly has a very decided and lasting effect upon the foulness of the breath. The offensiveness of the breath is also controlled to some extent by mouth-washes and gargles of the less irritating antiseptics and aromatics, as, for instance—

| | |
|---|---|
| Thymol | 2 |
| Oil of cloves | 1 |
| Oil of cassia | 0.5 |
| Chloroform | 5 |
| Alcohol | 25 |

of which one teaspoonful is dissolved in a glass of water (8 oz.).

The constitutional treatment of diphtheria and the methods of quarantine and disinfection can be found in all text-books on general medicine. The indications and surgery of intubation and tracheotomy are likewise outside of the scope of the present work.

**204.** Individuals exposed to the disease are protected against it almost infallibly by a prophylactic injection of at least 150 units of antitoxin, if given within twenty-four hours after exposure. Two or three days after exposure a larger dose (600 units) is required, and even this may not protect absolutely, but infallibly reduces the disease to a very mild type. The passive immunity pro-

duced by antitoxin injection lasts a number of weeks, not exceeding about six.

**205.** A singular and exceptional form of *chronic* disease apparently due to the diphtheria bacillus has recently been reported (Neisser and Kahnert). Five instances were observed, all in young women. For years they had complained of dryness in the throat, discomfort, even some pain, and viscid secretion, but practically only during the cold season, with apparent intermission during summer. Purulent crusts without fetor were found in the nose and entire pharynx down to the larynx. The mucous membrane appeared atrophic, somewhat vulnerable, partially congested. The symptoms resembled those of non-fetid atrophic rhinitis, but with extension through the pharynx. The only micro-organism found absolutely constant was the typical genuine diphtheria bacillus, but devoid of pathogenic property in some of the cases. In one instance only the disease dated from a former attack of diphtheria. The serum of several patients had antitoxic efficiency. Injections of antitoxin did not influence the disease.

# CHAPTER XXV.

## SYPHILIS OF THE NOSE AND PHARYNX.—TUBERCULOSIS.—SCROFULA.—LEPROSY.—RHINOSCLEROMA.

### SYPHILIS OF THE UPPER AIR-PASSAGES.

**206.** In the course of syphilis the pharynx is involved, as a rule, during the early period of secondary manifestations. But this form of lesion is not often seen by the rhinologist. Yet syphilitic manifestations in general are so common in the nose and throat that they constitute at least 2 per cent. of average practice in this field.

The primary sore, very exceptionally found in the nasal vestibule or near the front end of the septum, is not so rare in the mouth and pharynx. In statistics of over 10,000 cases of extragenital chancres compiled by Bulkley, and continued by Münchheimer, 5 per cent. were observed in the tonsils and nearly 3 per cent. in other parts of the pharynx. The infection was conveyed partly by lascivious modes of kissing and sexual aberration, partly by utensils and tools—for instance, the blowpipe of glass-workers. More than 50 pharyngeal chancres have been reported from the use of infected Eustachian catheters. Infants acquire the disease by nursing. The sore appears as a sharply cut ulcer with unclean surface, surrounded by an edematous and reddened areola, of indolent course, lasting weeks, even up to two months. Usually but not always the base becomes indurated. Adjacent lymph-glands become inflamed and palpable. The diagnosis cannot be made absolute unless the history of exposure is certain, or until secondary symptoms appear. Yet the only ulcers for which it might be mistaken—after an existence of two weeks or more—are secondary

syphilitic ulceration, tubercular ulcers, and ulcerating carcinoma.

Until the diagnosis is beyond the possibility of doubt it is not to the interest of the patient to use specific medication. If a sore disappears under specific treatment before its nature is certain, the diagnosis of syphilis may be left in uncertainty for months and years. The ulcer heals in the end without treatment, but its cure can be hastened by nitrate of silver, tincture of iodin, or Löffler's solution, and its discomfort lessened by orthoform insufflations.

**207.** During the early secondary stage the throat, as a rule, is affected by syphilis. But as these lesions are relatively mild and their cause is usually known to the patient, they are but seldom seen in special rhinologic practice. Syphilitic erythema, common on the palate, less so on the posterior pharyngeal wall, appears in the form of red, well-circumscribed spots, often symmetric. It causes slight soreness and is transient. It may persist, however, as a deeper type of inflammation in the form of a tonsillitis, presenting sometimes the typical appearance of follicular tonsillitis. Whenever this lasts more than about a week, with steady but moderate soreness and without acute onset, it can be safely referred to syphilis.

Mucous patches are among the most frequent and persistent of the early syphilitic manifestations, with distressing liability to recurrence. They occur anywhere in the mouth—on the tongue, or at its base, along the pillars, on the tonsils, or less commonly the posterior wall of the pharynx. At first resembling spots produced by cauterization with nitrate of silver, they are oval or irregular, slightly raised, grayish-white patches of variable size, surrounded by a slightly reddened areola, the color of which is most saturated (by contrast) at the edge of the gray patch. In mild or well-treated instances they may disappear in the course of one to two weeks. But, as a rule, they undergo further changes. The epithelium becomes macerated and gradually detached, and

a slightly bleeding sore surface remains. This may proceed to deeper ulceration if not treated, especially on the tonsils. By the coalescence of several elliptic ulcers a characteristic "serpiginous" appearance is often produced. The ulcers may become complicated by secondary infection, mainly with streptococci, but even occasionally with the diphtheria bacillus.

In the nose early secondary manifestations are said to be rare or at least give rise to so little disturbance that they are not recognized. The writer, however, has a few times seen very persistent superficial ulcerations on the septum, serpiginous in appearance, but without tendency to extend in depth. They were probably the outcome of mucous patches, and when recognized after a duration of months, yielded quite promptly to specific treatment.

**208.** The later or so-called tertiary forms of syphilitic localization in the nose and throat are not rare. They may appear within one year after infection, but are much more common at later periods, even twenty years or more after the beginning of the disease. In the pharynx the lesion is a gummatous infiltration. It is either relatively diffuse and superficial, being in the mucous membrane itself, or it may be a more circumscribed nodule in the underlying tissues. Its preferred site is the soft palate, less often the pillars, but it may occur on the posterior wall or the lingual tonsil, or be hidden in the naso-pharyngeal space. It causes but little disturbance until it ulcerates, which happens in the course of one to two weeks, unless energetically treated from the start. When the gumma breaks down, a small, well-defined, often crater-shaped opening is found, from which a thin purulent secretion issues. If healing is not brought about by prompt treatment, further extension of ulceration follows, probably dependent on secondary infection with other microbes. In the soft palate a gumma usually opens on both surfaces, and causes thus a permanent perforation. If situated on the posterior wall or the pillars, the ulceration is likely to lead to extensive shrinkage and

adhesions after healing. Very serious mechanical disturbances may result therefrom. In some instances gummatous ulceration of the throat has given rise to serious, even fatal, hemorrhages. In the nasopharynx syphilitic ulceration causes severe headache and profuse secretion. Postnasal examination with the mirror should not be neglected in syphilitic patients with symptoms of disease above the palate.

Within the nose, syphilis can produce a number of well-defined lesions which can be distinguished as—

Gummatous infiltration.
Ulceration of the septum.
Necrosis of bony wall.
Diffuse hypertrophic rhinitis.
Syphilomatous tumors.
Ultimate atrophy of the mucous membrane.

**209.** Gummatous infiltration appears as a more or less circumscribed tumefaction mostly on the septum, in its upper and anterior area, to a less extent along the floor or on the inferior turbinal. In other localities it is quite uncommon. During the formation of the gumma it may cause considerable aching pain or headache, especially if on the septum. Otherwise no symptoms are produced except slight stuffiness, but breaking down of the gumma is sure to follow unless it is promptly treated. A crater-shaped fistula results, leading into considerable depth. The purulent secretion issuing is likely to dry in the form of crusts. From this time on there may or may not be associated with the localized gumma a diffuse rhinitis with profuse discharge of pus. The ulceration of the gumma shows no tendency to extend in area except when situated on the septum.

**210.** Late syphilis leads often to characteristic perforation and destruction of the septum. It is not definitely known whether this ulceration always starts from a distinctly localized gumma or not. It begins usually in the cartilaginous portion, often but not always quite high up,

but is sure to extend to the bony septum unless checked. It is a typical progressive caries. If not checked, it will destroy a large part of the septum in the course of months or years. The perforation is rarely seen when very small, as probably a fairly large area sloughs away at once. It has not the typical round form of the non-syphilitic perforating ulcer. Its edges are thickened and often deformed. The ulcerated edge secretes a thick pus, which dries in adherent, yellowish-green crusts. Quite commonly there is, besides, free purulent secretion from the entire nasal surface. (Compare Fig. 2, Plate I.)

In the course of time caries of the septum is followed by deformity of the external nose, sometimes with pitiful disfiguration. Of course, all possible degrees of deformity may be seen, from slight sinking in of the bridge to a typical saddle-shaped nose, or a retraction of the entire external organ, leaving two up-turned apertures. Even these may be disfigured or narrowed if gummatous infiltration of the alæ nasi has been allowed to do its ravages without check. The sinking in of the nose is not due to the mere defect of the septum. Even a very large perforation leaves the septum strong enough to support the bridge. Indeed, the latter is practically self-supported by the architecture of the nasal bones. Moreover, the sinking in does not occur during the time the perforation extends, but usually follows it at a later period. The retraction is due to cicatricial shrinkage of the septum, and is rarely seen in patients who have been properly treated, even though they have a large hole in the septum.

**211.** Essentially different from the caries of the septum is syphilitic necrosis of the bony walls. This is not a progressive lesion. It is practically never seen at its beginning when the patient merely complains of some stuffiness. It probably begins as a syphilitic disease of the arteries of a small area, leading to their obliteration and to the death of a circumscribed sequestrum of bone. The piece of dead bone varies in size as much as ordinary coins do. It is more often a fragment of two adjoining

walls than a single plane lamella of bone. Its most frequent location is at the rear area of the junction of the horizontal plate of the palate bone and the vomer, but it may occur almost anywhere. Perforations of the hard palate with opening between mouth and nose are common and characteristic. As a rule, they are small on account of the integrity of the lining membrane of the mouth. The maxillary sinus may be opened by necrosis. A portion of the ethmoid labyrinth may come away. In one case on record the sphenoid body was thrown off. The symptoms which compel the patient to seek advice are the offensive discharge and the horrible stench. The latter is absolutely characteristic of syphilitic necrosis. It cannot be influenced in any way whatsoever until the piece of dead bone is removed. No matter how accessible the sequestrum may seem, deodorizing substances will not conquer the smell. By the use of douches with permanganate of potassium and sprays of essential oils the patient can merely make his presence tolerated until the dead bone is removed. The sequestrum can be felt by the probe. On account of the intricate anatomy of the nose it would usually require a formidable operation to remove the sequestrum. It is hence the wiser plan to wait until it is nearly detached, when it can be seized with forceps and extracted. This may take from three to six weeks or even longer. By breaking off a portion of the sequestrum and leaving a part in place, nothing is gained. Within a few days after the dead bone is cast off the odor ceases. The necrosis is not progressive, and hence as such is not influenced by specific treatment. But it is commonly associated with a purulent rhinitis, which is of specific origin and which yields to internal medication as soon as the necrotic piece of bone has been expelled.

**212.** In connection with the various lesions described there is, as a rule, a diffuse purulent rhinitis with moderate diffuse swelling of the nasal mucous membrane. This form of syphilitic rhinitis is characterized by a profuse, thick, greenish-yellow discharge tending to dry in the

form of adherent crusts. If there is no bony necrosis, no odor is present at first. But by reason of neglect secondary decomposition may take place and give rise to a foul smell. Characteristic of the disease is its tendency to form broad adhesions. Synechiæ, especially when multiple, between the septum and the turbinal processes are almost diagnostic of syphilis, unless clearly due to improperly done operations or cauterization. This purulent rhinitis, unlike most syphilitic lesions, is not self-limited if not specifically treated. During its earlier period it yields to internal medication, aided by local measures, though not always promptly. If it has been allowed to turn into atrophy of the mucous membrane, it is almost incurable.

**213.** A special form of localized nasal hypertrophy of syphilitic origin is the syphiloma, a tumor of granulation tissue. The tumor, sometimes multiple and variable in size, is soft and friable and easily broken down by manipulation. In color it is grayish pink. It may spring from the septum or from a turbinal. It is often, but not always, associated with gummatous infiltration or some destructive process adjacent to it. Besides local stuffiness and discharge, it may give rise to distant symptoms like headache. It is a rare lesion, and may create difficulty in diagnosis. Histologically, it cannot be readily distinguished from tubercular tumors and soft sarcomata. It consists of mucous membrane infiltrated with round cells, so as to give it the structure of granulation tissue, often containing some giant cells. Its arteries are characteristically thickened by round-cell infiltration. The best plan is to remove it at once by the use of the snare. A relapse, however, must be expected unless specific treatment is pursued.

**214.** When syphilitic rhinitis is not checked in the beginning by specific treatment, it proceeds to the stage of atrophy of the entire nasal mucous membrane. The clinical appearance is now strikingly like that of advanced ozena—viz., large spacious passages with rudi-

mentary appearance or nearly complete absence of the turbinals, and thin, dry, cicatricial looking mucous membrane lined with adherent greenish crusts (Fig. 84). The presence of any ulceration or perforation of the septum distinguishes it absolutely from non-syphilitic ozena.

FIG. 84.—Syphilis of the nose; external nose sunken in; alveolar process defective, and communication between nose and mouth; septum almost entirely destroyed, except at its rear end. The alæ nasi are enormously thickened, and the mucous membrane is mostly hypertrophic. Inferior turbinal atrophied, especially in front; middle turbinal atrophied in front, enlarged toward the rear; hiatus semilunaris exposed by reason of atrophy of its bony boundaries while the surrounding mucous membrane is considerably hypertrophied (Zuckerkandl).

The odor, too, is not quite that of ozena, though it may resemble it closely. In some instances there is no odor. At this stage the disease is practically incurable. The annoyance may be lessened by the continued use of douches and Gottstein's tampons. Specific treatment has no influence upon it.

**215.** All specific lesions in the nose and throat are very readily controlled by internal treatment if begun early. The earlier or secondary manifestations require mercury. Its effect is the same whether given internally, by hypodermic injection, or by inunction. The latter mode is regarded as the most thorough and permanent in its effects. It is not necessary, and, indeed, very undesirable, to induce salivation or disease of the gums. This should be guarded against by thorough attention to the teeth by removing tartar and by mechanical cleansing. Thorough dental cleanliness should be enforced. The gums may be hardened by using finely powdered salt upon the tooth-brush. Care must be taken not to permit the presence of decomposing food between the teeth, and any cavities should receive the attention of a dentist. The slightest salivation or tenderness or bleeding of the gums should cause a temporary intermission in treatment. If the gums become affected, they may be brushed with diluted tincture of myrrh (1 : 20), and a mouth-wash of thymol solution and oil of cloves (¶ 134) may be used at short intervals. Chlorate of potash tablets kept between gums and cheek seem also to be of some service.

Iodid of potassium has a less pronounced influence on the early specific lesions, unless they assume a gummatous appearance independent of their recent date. In later manifestations iodid is the sovereign remedy. Its dosage must be increased rapidly until an effect is obtained, which should be apparent in four or five days. It is best to begin with 15 drops of the saturated solution in order to guard against unpleasant effects, which may exceptionally occur in case of idiosyncrasy. The dose should be increased by 5 drops each successive time (three times daily) until an effect is obtained or up to the limit of tolerance. In exceptional cases as much as 8 to 10 grams per dose may be required—usually one-third of this suffices. It is tolerated best when given after meals in several glasses of fluid, preferably milk. A slight degree

of iodism need not interrupt its administration, as these untoward symptoms may disappear in spite of its continued use.

Local treatment is often required in addition on account of the complication by secondary infections. Ulcerated surfaces are benefited by nitrate of silver application (20 to 30 per cent.) or Löffler's solution. The pain of ulcers in the pharynx is alleviated by orthoform. Nasal suppuration requires removal of discharge by the douche or at least the frequent cleansing with liberally used sprays. When the nasal secretion dries in the form of crusts in spite of these measures, this occurrence can be prevented by tampons of cotton or gauze. When applied to raw surfaces, iodoform gauze for the tampon is a distinct advantage, but not if in contact with intact mucous membrane. The patient must, of course, be consulted whether he will permit the iodoform odor.

**216.** Inherited syphilis can produce the same lesions in the nose and throat as the acquired disease. This may occur at any time from earliest childhood to adolescence or beyond. The sunken-in nose is, unfortunately, a frequent stigma of hereditary syphilis. Many authors refer to the frequency of diffuse purulent rhinitis (snuffles) in syphilitic infants. The writer has not been convinced, either by personal experience or from any definite statements in literature, that the often reiterated statement that severe coryza in a nursling is strongly suggestive or even indicative of syphilis is based on careful observation. Various syphilitic lesions, some of them complicated with the above-described specific purulent rhinitis, may occur even at the earliest period of life. But, on the other hand, the majority of instances of coryza in syphilitic infants are probably not specific in origin, but are merely acute nasal inflammation complicated by hypertrophy of the pharyngeal tonsil. As soon as the diagnosis of a nasal specific lesion can be made, the infant should, of course, receive specific treatment.

The writer has not attempted to give more than a mere

outline of the treatment of syphilis, since fuller details can be found in any special work on syphilis.

## TUBERCULOSIS.

**217.** Tuberculosis does not often cause clinical manifestations in the nose or pharynx. In most instances the tubercular lesions are secondary to other foci of the disease in the body. Yet occasionally primary infection is encountered. The disease begins as a superficial infiltration of the mucous membrane with miliary tubercles in a small area. The spot appears unevenly swollen and congested and is easily eroded. It changes soon into an ulcer with ill-defined edges, grayish-yellowish surface, and surrounded by flabby, bleeding granulations. Adjoining the ulcer, but sometimes, too, without ulceration, the disease produces, in rare instances, tumors of granulation tissue of pinkish-gray appearance and spongy consistency—tuberculoma, which may puzzle the diagnostician.

In the nose tubercular disease affects the septum more frequently than other parts of the wall. At the entrance of the nose tuberculosis of the mucous membrane is sometimes evidently due to extension of lupus of the adjacent skin. In the pharynx its site by preference is the soft palate. When the uvula is involved in infiltration, it is characteristically changed into a thick, misshapen stump. When not involved, it appears unproportionately thin. Less often than on the soft palate tuberculosis may invade other parts of the postnasal space or pharynx.

In the nose it causes but moderate disturbance, stuffiness, seropurulent, fetid discharge, not rarely, however, headache and feeling of heaviness. In the lower pharynx tubercular ulceration causes great pain during swallowing, and if not relieved, may lead to starvation. It gives a very foul breath, probably from secondary invasion by concomitant bacteria. In the nasopharynx tubercular ulceration may run an almost latent course. Wherever

situated, tuberculosis pursues a slow but steady progress unless checked therapeutically.

The diagnosis is usually not very difficult. The presence of cutaneous lupus or the appearance of yellowish miliary tubercles at the edge of the spot confirms the suspicion raised by the above-described appearances. The histologic structure of tubercles in excised fragments or the demonstration of the tubercle bacillus renders the diagnosis absolute. In case of doubt certainty can be obtained from a diagnostic injection of tuberculin.

**218.** The treatment is essentially surgical. The tubercular tumor is snared off. The ulcer is curetted and cauterized. Opinions are divided as to the preference for the galvanocautery or the application of lactic acid (the latter on a pledget of cotton). A fair minority of permanent cures have been reported. As a rule, the disease cannot be completely eradicated, especially when complicated by tuberculosis of other organs. The patient should receive all possible benefits in the way of hygienic management and climatic environment that can be given him. Tuberculin has received scarcely a fair trial in this disease, as the lesions are usually seen at an advanced period beyond the power of this specific agent. The pain of pharyngeal ulceration can be well controlled by orthoform.

**219.** Much discussion has taken place within the past few years as to what extent the tubercular virus enters the system through the upper air-passages. It was startling news to learn that among the healthy attendants in the tubercular wards of hospitals a large number show the presence of tubercle bacilli on the surface of the intact nasal lining. In all probability the presence of the normal mucus and the movement of the epithelial cilia ordinarily prevent infection. Further research has shown, however, that tubercles are not uncommon in the hypertrophied pharyngeal and faucial tonsil. Various observers have found miliary tubercles with characteristic bacilli in sections of excised tonsils, in

some instances as often as one out of every six. A larger number of observations has shown an average of about 5 per cent. This form of tuberculosis is entirely latent, and such tubercular tonsils cannot be distinguished from ordinary hypertrophy. The significance of this frequent tubercular infection is somewhat reduced by the fact that it is almost invariably secondary to tubercular disease of other organs, especially the lungs. It is, indeed, not proven that it does ever occur as a primary invasion. On the other hand, it has been shown that in autopsies of subjects dead of tuberculosis tubercles are found very commonly in faucial tonsils, perhaps a little less often in the pharyngeal tonsil. This is true even when the tonsil is not morbidly enlarged. Although clinically latent, tuberculosis of the adenoid structures is not harmless, as it leads to descending tuberculosis of the cervical lymph-glands and may thus help to disseminate the disease through the body. The excision of tubercular tonsils causes no reaction different from that in ordinary cases.

**220. Scrofulosis** has often an important relation to the upper air-passages. At present it is almost generally admitted that this disease is really but a form of tuberculosis, the reaction of the juvenile organism to poisons generated in some tubercular focus, usually in a lymph-gland. The lesions produced by scrofulosis in the nose and pharynx are not in themselves tubercular. The most characteristic manifestation is the subacute seropurulent rhinitis of scrofulous children, described in ¶ 35. A thin discharge, variable with the season, frequently relapsing, and often associated with eczema below the nose, produces a typical picture. This rhinitis is the frequent precursor of phlyctenular keratitis, a characteristically scrofulous affection. Scrofulous children are commonly subject to enlargement of the pharyngeal tonsil in connection with the rhinitis described. There is, as a rule, but a minor degree of adenoid hypertrophy. It is, however, rare to find a scrofulous child without some

adenoid enlargement. On the other hand, it cannot be said conversely that enlargement of the pharyngeal tonsil is necessarily indicative of scrofula. But some of the symptoms formerly referred to scrofula are largely dependent upon the hypertrophy of the tonsil. The frequent attacks of nasal catarrh, the thick lips, the liability to purulent otitis, all formerly considered manifestations of scrofula, are the direct results of the pharyngeal hypertrophy.

## LEPROSY.

**221.** Although this disease is but a rare curiosity in our part of the country, it invades the upper air-passages so often that a few diagnostic comments seem proper. It has been claimed recently by Sticker that lepra begins, as a rule, in the nose in the form of septum ulceration, and that this is one of its most persistent manifestations, all the more important because the nasal discharge contains the specific germs in abundance. The lesions in the nose and pharynx consist of follicles which coalesce and ulcerate. In the course of time a spontaneous healing takes place, resulting in smooth but extensive scars, sometimes with a good deal of shrinkage. The diagnosis is said to be fairly definite from local appearances, but depends mainly on the detection of the systemic disease.

**222. Rhinoscleroma,** or scleroma of the upper air-passages, is a disease which requires description in connection with the diagnosis of syphilitic and tubercular lesions. It is very rarely seen in this country, and only in emigrants, but is quite common among the poor in Poland and the eastern and southern provinces of Austria. It is a chronic, slowly progressive, incurable disease, which may not destroy life until at a very late period. The lesion consists of nodular infiltration, sometimes diffuse, sometimes circumscribed, often multiple. The nodule, of hard and variable size, sometimes as large as a bean, begins often in the skin of the external nose, and may extend through the upper lip. In other instances it commences in the pharynx. Gradually the process ex-

tends throughout the entire air-passages, including the larynx and trachea. There is not much ulceration, but rather a superficial erosion, with very profuse purulent discharge, drying in the form of crusts. The disease is identical with the blennorrhea of the air-passages described by Stoerck. In the course of time the infiltrated mucous membrane shrinks, and the resulting extensive scars often lead to narrowing of the pharynx or larynx. Tracheotomy may become necessary in order to prolong life.*

When the diagnosis cannot be made from the appearance, an excised fragment can be examined microscopically. It shows granulation tissue, with some typical large oval cells. In the tissues short bacilli are found in great abundance, which resemble closely the pneumobacillus of Friedländer or the bacillus mucosus of ozena. They are justly regarded as the cause of the disease. Scleroma cannot be influenced by any treatment.

## CHAPTER XXVI.

### AFFECTIONS OF THE UPPER AIR-PASSAGES IN THE COURSE OF OTHER DISEASES.

**223. Measles.**—This disease is characterized by congestion and irritation of the conjunctiva and the mucous membrane of the entire upper air-passages from the start before the cutaneous eruption appears. With good illumination miliary red spots can often be seen on the first or second day on the nasal mucous membrane, and still more distinctly on the soft palate and tonsils, as well as on the inside of the cheek. The diagnosis can thereby be made before the rash appears on the skin. In the milder cases the nasal and the throat lesions pass over without further complication. In cases of moderate severity a secondary coryza sets in, sometimes quite persistent. Tonsillitis is a relatively rare complication, but any exposure to diphtheria is very likely to lead to infection as a sequel to measles. Nasal hemorrhages are not uncommon before the rash appears. The nasal sinuses are probably involved often, but it is very rare that their affection is clinically evident.

**224. Scarlet Fever.**—It is very rare and seems to occur only in the mildest cases that scarlet fever is not ushered in by an eruption in the throat, especially on the soft palate. This is usually the first localized symptom of the disease. It consists of dusky red, more or less coalescing spots, the injection usually spreading over the tonsils, and to some extent over the posterior wall of the pharynx. Occasionally scarlatina begins with a distinct tonsillitis. In cases of moderate severity the eruption fades as the cutaneous rash disappears. In a large proportion of average and severe cases, how-

ever, there is a secondary throat affection varying from superficial inflammation to formation of diphtheritic false membranes or even gangrenous sloughing. The corresponding lymph-glands are always swollen and tender. These throat lesions are mostly due to infection by streptococci. Scarlatinous diphtheria, however, is in some cases the result of secondary infection by the diphtheria bacillus. The diphtheritic affection, due to the streptococcus, does not show the tendency to extension found in true diphtheria. Extension to the larynx is not frequent. But from the start the more severe forms of throat affection, even those without false membranes, show a septic character and septic and pyemic sequels are not uncommon. Purulent involvement of the ear is likewise a very frequent sequel. The throat affection, if of any severity, may last two to three weeks. Treatment has but a moderate influence. Antiseptic gargles and sprays (thymol or the essential oil solution (see ¶ 25 and ¶ 134)) are of some service. The most active but disagreeable local application is Löffler's solution (¶ 25).

The nose is not involved as often in scarlet fever as the throat. The initial rash is said to be visible on the nasal mucous membrane in many instances. In a small proportion of the more severe cases a purulent, sometimes a membranous, rhinitis occurs as a sequel. Autopsies show that in fatal cases disease of the nasal accessory cavities is quite common, but clinically this is usually not recognizable.

**225. Small-pox** is sometimes ushered in by nasal hemorrhages. They are said to be of more serious prognostic significance in adults than in children. It is stated that, as a rule, characteristic papules appear on the palate and tonsils even earlier than on the skin, and that these follow the usual course and change into pustules.

**226. Typhoid fever** is attended by hemorrhage from the nose in nearly one-half the cases, especially in young people. Occasionally the bleeding is alarming. During the later stage pharyngitis is not uncommon and some-

times small oval ulcers of some persistence are seen, but with little liability to extend.

**227.** In **leukocythemia** nasal hemorrhages occur in perhaps half the cases at different times.

**228. Influenza.**—This disease has changed its character considerably in different years since its extension throughout the world in the form of an epidemic in 1889. In some years nasal affections seem quite uncommon; in others they are frequent. Autopsies have shown the frequent involvement of one or more nasal sinuses. Probably many of these instances escape clinical detection. In others the usual symptoms of sinuitis, especially of the ethmoid cells and of the sphenoid sinus, are present. The sinus affections are more often due to secondary infection by streptococci and other germs than to the influenza bacillus itself. Some of the influenza epidemics are complicated in many instances by severe purulent rhinitis, very liable to become subacute or chronic and often leading to early, sometimes to late, involvement of the ears. The throat suffers only exceptionally in this disease.

**229. Herpes.**—Herpes febrilis, the familiar "cold sore," occasionally involves the pharynx. This occurrence is very uncommon in this part of the country. The pharyngeal affection may occur in connection with herpes of the lips or sometimes without the latter. It begins with a sharp fever lasting not over a day. The herpes vesicles in the pharynx may be few in number or very numerous. The amount of congestion corresponds to their number. Sometimes they heal within a few days; more often each vesicle changes to a superficial ulcer with yellowish deposit. Occasionally several coalesce and form a diphtheritic-looking membrane. This may protract the disease and confuse the diagnostician. Herpes is said to attack some persons in frequent relapses during the whole life. If the vesicles do not heal spontaneously within a few days, the ulcers may be touched with nitrate of silver with advantage.

**230.** A few instances of **herpes zoster** of the pharynx have been recorded. The vesicles are larger than in febrile herpes, and lead to deeper and more lasting ulceration. As a rule, the spots are one-sided. There is considerable pain, sometimes of a neuralgic order, and its presence and persistence suggest the diagnosis.

**231. Diabetes mellitus** is said to reveal itself often by persistent dryness of the pharynx. The writer has never observed this symptom in diabetes. Recently ulceration of the pharynx has been described as a complication of diabetes (Freudenthal). The ulcers on the tonsil, pillar, posterior wall, or base of the tongue may be superficial or may extend deeper. They resemble tubercular ulcers, but bacilli cannot be found, and, unlike tubercular disease, they can be readily cured. The pain which they cause interferes considerably with nutrition.

**232. Rheumatism.**—Rheumatism has no relation to any nasal lesion, but it is very frequently referred to by authors as an etiologic factor in tonsillitis. This is partly due to a misconception as to cause and effect. A number of observers have noted that rheumatism may follow acute tonsillitis. Indeed, tonsillitis is a frequent antecedent in attacks of acute rheumatism, so much so that the latter must be regarded in many instances as the consequence of an inflammation of the tonsil. It is, however, an open question whether this is ordinary tonsillitis or an inflammation due to the invasion by the specific, as yet not identified, virus of rheumatism. The tonsillar origin of rheumatism has been stated as high as 80 per cent. (Fowler). But most observers give very much lower figures (5 to 20 per cent.). It has also been noted that patients with the history of former rheumatism are prone to attacks of acute tonsillitis. But the frequency of this factor in the etiology of tonsillitis is, after all, a very small one when compared with the prevalence of tonsillitis, especially in children. Even in distinctly rheumatic subjects acute tonsillitis follows its ordinary

rapid course and is not influenced to any demonstrable extent by antirheumatic treatment.

Some forms of chronic tonsillitis have been ascribed to a rheumatic basis. The descriptions of different authors are, however, so discordant, and their criteria of rheumatic origin so indefinite, that no positive conclusions can be stated. The writer's personal experience has made him familiar with a form of sore throat of indefinite duration, fairly frequent, which in most cases can be influenced promptly by the liberal use of salicylate of sodium. The patient complains of pain in swallowing, which he cannot localize. Inspection shows some diffuse redness, but no localized inflammation of the mucous membrane. The lesion is in all probability a rheumatic inflammation of the fibrous fascia of the pharynx, and not an affection of the mucous membrane.

**233. Iodism.**—The internal use of salts of iodin produces, in some persons, symptoms of nasal irritation. The patient feels "dumpish," the head is "stuffy," the nose full and obstructed, like in a fresh "cold," and secretes an abundant thin mucus, but no pus. This may or may not be associated with other evidences of iodin poisoning, such as acne pustules, foul breath, and disordered stomach. Inspection shows turgescence of the nasal lining, but not necessarily any hyperemia. As a rule, the nasal irritation subsides within a day on withdrawing the drug, or it may even cease in spite of its continuance in larger doses. Very rarely it changes to a purulent rhinitis. Iodic irritation of the nose is due to the "idiosyncrasy" of some patients, and may come on even after small doses. Unless severe or persistent, it need not prevent the continued administration in increasing doses.

## CHAPTER XXVII.

### TUMORS OF THE NOSE AND PHARYNX.

**234.** Neoplasms within the nasal cavity are of uncommon occurrence aside from the inflammatory hypertrophies—viz., polypi and papillomata. **Polypi** are found clinically in about 2 per cent. of nasal patients, but in dissections of unselected subjects Zuckerkandl saw polypi present in about 10 per cent. Papillomata are considerably less frequent. These overgrowths of inflammatory origin have been described in ¶ 99 to ¶ 104. In the present place it is necessary to refer to them simply from a diagnostic point of view, and in order to point out their relation to other growths. A variety of nasal tumors, both benign and malignant, can assume a polypoid shape, and may hence be mistaken for mucous polypi. Such polypoid shape may be assumed by a hard fibroid, an angioma, sarcoma, adenoma, carcinoma, and syphilitic or tubercular granulomatous tumors. From all these the true mucous polypus can be distinguished by its smooth, glistening surface, its relative softness without tendency to bleeding, and in most instances its edematous condition, while its color varies from that of the normal mucous membrane slightly injected to a yellowish-gray gelatinous appearance when markedly edematous. Polypi may, however, be associated with other tumors, especially angiomata, so that in complicated cases the diagnosis is not always simple. Polypi grow mainly from the middle turbinal and the various ethmoid lamellæ. They have been very rarely seen attached to the septum.

**235.** Next in order of frequency are the **papillomata.** In well-marked instances these wart-like tumors are of raspberry or mulberry shape, of reddish or violet hue,

sometimes single, sometimes multiple. From the typical papillomata as large as a cherry there are all gradations down to the most insignificant, scarcely circumscribed, hypertrophic elevation of the mucous membrane. This tumor, like the polypus, is of inflammatory origin, and usually associated with purulent rhinitis. Its favorite site is somewhere on the inferior turbinal, less often on the nasal floor. It is not frequently met with on the septum. When found at the front of the septum the papilloma resembles the cutaneous wart by its decided cauliflower appearance, due to indentation by its proliferated epithelium. These hard septal papillomata are regarded with distrust on account of their possible transformation into malignant epithelioma, especially in elderly people.

**236.** Nasal tumors produce at first very little disturbance. The obstruction to breathing is not pronounced until at a late stage, and is often ignored by the patient. It is hence quite rare that tumors are seen at an early period. The one symptom which leads most frequently to their early detection is bleeding from the nose.

**237.** The tumor which more than any other reveals itself by bleeding is the "**bleeding polypus of the septum.**" It is a single polypoid excrescence on the septum, of the size of a shot to that of a pea, bleeding freely on touch. It is always one-sided. It is rarely found in men, mostly in adult women. In structure it is either granulation tissue with dilated vessels, or a pure angioma or a mixed fibro-angioma. Its only significance is its liability to bleed and its recurrence after incomplete operation. It should be radically removed by the snare (and curet) or the galvanocaustic burner.

**238.** Another form of bleeding tumor is the pure or mixed **angioma** in other sites. Although not frequent, these growths are of considerable importance, on account of the very free bleeding to which they may give rise. This vascular tumor appears of the color of the normal mucous membrane, is soft, even flabby, and bleeds upon

the slightest touch. It springs mainly from the external wall in the form of a diffuse tumefaction, sometimes lobulated enough to be polypoid in shape. It is made up of cavernous tissue, dilated venous channels with thin walls. On account of the prevalence of cavernous tissue throughout the nose, different nasal tumors, such as sarcomata, adenomata, and at times even harmless mucous polypi are apt to be in part of angiomatous structure, which point must be remembered in the diagnosis. The unmixed angiomata may extend into adjoining spaces like the orbit, and may thus prove quite annoying, although not at all malignant. Vascular tumors can be safely removed with a cold snare, provided they can be thoroughly grasped. It is necessary to use a snare with screw-nut, which can be drawn home very slowly in order to avoid hemorrhage. When the snare cannot be satisfactorily used, the attachment of the growth may be cut through with the knife-shaped burner in a series of sittings. The surgeon must be prepared, however, for very copious hemorrhage. Electrolysis by means of needles inserted near the base of the tumor is lauded by some, condemned by others. It requires a current of 10 to 25 or even more milliampères for five to ten minutes at a time, with many repetitions at intervals of a few days.

**239.** The **hard fibroma** is a rare form of nasal growth, which may become serious by pressure, on account of its continually increasing size. It is a firm fibrous structure with broad pedicle. When detected early, it can be removed with a snare. But after it has filled the nasal cavity or extended beyond its confines, it may require a major external operation in order to gain access to it.

**240. Cysts** are a frequent occurrence in the maxillary and frontal sinuses, but very uncommon in the nasal cavity. In rare instances a glandular retention cyst is found on the floor or on the external wall. Even less common is the development of a cyst in the septum secondary to a hematoma which has not gone to sup-

puration. The diagnosis of the cystic nature of the soft globular tumor can be established by puncture with a hollow needle. A radical cure requires either removal of the greater part of the cyst-wall or obliteration by injection of tincture of iodin, which is not always successful.

**241. Osteoma** is a rare form of nasal tumor springing from the floor or external wall, or originating in one of the accessory cavities. Its nature is recognized by its hardness. Its seriousness depends on its rate of growth and the displacement of tissue and organs to which it ultimately leads. If accessible by the intranasal method, it can be removed without much danger, but its hardness is such that it is necessary to chisel through the healthy bone from which it springs. If too large to be accessible from the nose, it may require a formidable operation in order to be removed. Even less common are cartilaginous tumors,—**chondromata**,—originating from the septum or sometimes from the ethmoid bone. These growths are apt to become detached from their matrix, being connected in that case only by means of a bridge of mucous membrane. When seen at this stage, their removal is very easy.

**242.** Spurs and ridges on the septum which are sometimes referred to as exostoses and ecchondroses should not be classified among tumors for reasons given in ¶ 114 and ¶ 115. The beginner should also be cautioned against the mistake of taking an expanded middle turbinal for a true tumor.

Reference must again be made to the occasional, though rare, occurrence of granulomatous tumors due either to tuberculosis or even more rarely to syphilis. Either tumor appears as a fleshy growth, readily bleeding on touch, the tuberculoma being the least firm of the two. The site is preferably on the septum, less commonly on the floor or external wall. Both of these forms of morbid growth are attended with seropurulent discharge, which in tubercular disease is usually very fetid. These tumors

may prove puzzles to the diagnostician. Microscopically they consist of rather firm granulation tissue, in part even fibrous. Tubercles may not be found except in some parts. Giant cells are met with both in syphilis and in tuberculosis. Tubercle bacilli, if present at all, are scant in number. In the syphilitic tumors the arterial walls are found thickened and infiltrated. If the history or concomitant lesions or the microscopic examination does not clear the diagnosis, it may have to be based upon the result of a diagnostic tuberculin injection or a week's employment of iodid of potassium in large doses.

**243.** Of malignant tumors, **sarcoma** is more frequent in the nose than true **cancer.** Both, however, are very rare. The former is more likely to grow rapidly, displacing the nasal walls, but less likely to ulcerate early, and hence to bleed, than carcinoma. The latter is also more apt to be painful. Sarcoma is essentially a disease of youth; carcinoma, of more advanced age. Either tumor presents itself as a firm reddish mass, often with eroded or ulcerated surface, and liable to bleed, especially when mixed with overgrown cavernous tissue. The sarcoma is sometimes pigmented. Such a melanosarcoma is not always as malignant in the nose as it is in other localities. The diagnosis cannot generally be made until after microscopic examination of a fragment, and even this may prove indecisive. Unless radically removed, these malignant tumors give a bad prognosis. Their removal is generally a quite formidable operation. Malignant tumors may escape detection until a late period if they originate in the maxillary or frontal sinus.

**244.** A tumor formed by the proliferation of the mucous glands, the so-called **adenoma,** is intermediate between benign and malignant tumors. The pure adenoma is probably extremely rare. Most of these growths are more of the nature of a true cancer. Relatively often it is a mixed type—adenoma with angioma. The writer's experience has probably been exceptional in observing a

radical cure for at least three years after the intranasal removal of a pure adenoma in an old man.

**245.** In the pharynx tumors, in the proper sense of the word, are likewise not common. Hypertrophy of the pharyngeal tonsil cannot be called a true neoplasm. In examining the upper pharynx, especially when exploring with the finger, the beginner should not be misled by an exceptional prominence of the first cervical vertebra, which may simulate a morbid swelling. *Edematous polypi*, which are sometimes found in the nasal pharynx, are, as a rule, of nasal origin, having grown beyond the posterior choanæ. The appearance of such a growth when seen in the mirror is like that of the ordinary nasal polypus. Its removal by the nasal or curved post-nasal snare may be quite difficult. Lange has suggested the use of a small stout blunt hook, introduced through the nose, by means of which the growth, supported as it is by the bony rim of the choanæ, can be torn from its attachment.

**246.** The most common, though by no means a frequent, neoplasm in the nasal pharynx is the hard **fibroid.** It occurs almost exclusively in boys, and if not previously fatal, it is said to disappear spontaneously about the twenty-fifth year of life. It is a firm fleshy tumor springing from the roof of the pharynx or the bony rim of the choanæ by a broad or often a multiple pedicle. It is apt to become eroded or ulcerated, and may then attach itself by adhesion to other surfaces. Felt at first only as a foreign body, the presence of which affects the voice and excites efforts at hawking, it becomes formidable as it continues to grow. Although not very vascular, it bleeds in many instances, often to an extent creating extreme anemia. Drowsiness is often noted as its symptom. The ulceration of its surface may cause sepsis, sometimes fatal. When allowed to grow, it fills the entire upper pharynx and occludes it absolutely. It may extend to the nasal chambers and expand the lateral walls, causing the disfiguring flattening of the face known as frog face.

Exceptionally it grows through the roof of the pharynx or nose, enters the cranial cavity, and kills by some cranial complication.

**247.** The removal of a postnasal fibroma may prove very difficult. The cold snare can generally not cut through its firm base. When the attachment is well accessible, the hot snare may answer. Considerable hemorrhage may be expected. Electrolysis has been employed with fair success. It requires, however, many sittings, sometimes months, until the detachments have either shrunk sufficiently or sloughed so as to permit complete removal. A current of more than 20 or 25 milliampères cannot be tolerated without narcosis. With anesthesia, currents of two to three times that strength have been employed. But even in that case many repetitions are necessary. When no urgent symptoms are present, electrolysis may be considered the safest mode of operating, and its tediousness may be shortened by finishing with a hot snare as soon as feasible. When these measures prove inapplicable, or when rapid removal is indicated, access to the postnasal space must be gained by some preliminary operation. The least formidable one is the splitting of the soft palate in the median line (leaving the uvula on one side). When fully accessible, the growth is dissected out, hemorrhage controlled by a tampon, and the palate sutured. In the case of large growths this method is rarely sufficient, and more extensive operations are required, either by a temporary resection of the superior maxilla or by entering through the side of the pharynx. The operation becomes one of considerable magnitude and danger.

*Fibrous* tumors are found in the lower part of the pharynx to a much less extent. Being easily accessible, they can be recognized earlier and removed without much difficulty.

**248.** The most common of all pharyngeal neoplasms are **papillomata.** In this locality their surface is always more or less cleft, like cauliflower, and the relatively

thick epithelium gives them a firm consistency. They are found mostly on the pillars or the uvula, sometimes hanging by a long thin pedicle.

**249. Vascular tumors** have been met with in the pharynx, especially on the tonsils. They vary from a superficial, nevus-like spot of vascularity to a tumor-shaped angioma. In the former case the condition is harmless and usually stationary, and requires, as a rule, no treatment. In the latter case the presence of the protruding tumefaction, the liability to further growth, and especially to bleeding, render operation necessary. The snare, hot or cold, should be used only if it can be applied to the base of the growth beyond the area of dilated vessels, otherwise an uncontrollable hemorrhage may result. If the shape of the growth does not permit the use of the snare, it may be dissected out with the knife-shaped burner, preferably in one sitting. Under some conditions of inaccessibility the better plan is to puncture the base of the growth with the pointed galvanocaustic burner, and thus induce gradual shrinkage and formation of an artificial pedicle, permitting subsequently an easier removal. In this case it is usually safer to puncture into healthy tissue beyond the growth. Electrolysis has also been utilized in this condition. It is easily manageable and fairly safe, but its extreme tediousness is an objection.

**250.** Some peculiarities are presented by tumors growing in the soft palate between its buccal and nasal surfaces. They have been termed *intramural* tumors. The majority of them are benign—a fibroma or rarely a cyst or a lipoma, but occasionally an adenoma or a malignant sarcoma. In either case the tumor is encapsulated and not difficult to dissect out from the buccal side. The diagnosis of the nature of the tumor cannot generally be made until after its removal.

**251. Malignant tumors** in the pharynx are not much less frequent than benign growths. Of these, cancer is rather more often seen than sarcoma, the former especially in advanced life, the latter in youth. The symp-

toms may remain trivial for some months. Gradual interference with speech and deglutition, pharyngeal irritation, and secretion lead to their detection. Carcinoma is, as a rule, painful in its late stages. Either tumor may finally cause starvation on account of the difficulty in swallowing. The main sites are the tonsil, the lingual tonsil, and the palate. The posterior wall is least often affected, and if at all, more likely secondary to a laryngeal growth. Sarcoma is rather a more distinctly circumscribed tumor than carcinoma, which appears and spreads usually as a diffused infiltration with early ulceration. In sarcoma ulceration occurs later, if at all. The breaking down of the growth gives rise to awful fetor of the breath. Cachexia becomes marked by this time, and may become complicated by sepsis. Subacute inflammatory attacks frequently start from the growth, and sometimes cause much inflammatory edema. Corrosion of large arterial twigs, occasionally with fatal hemorrhage, has been observed. Unless a radical operation is feasible, death is only a question of time. In the diagnosis of malignant growths, especially of carcinoma, all obtainable evidence must be carefully weighed in order to decide between this process, syphilitic chancre, gumma, and tuberculosis. The cervical lymph-glands are enlarged early in cancer and primary syphilitic sores; often, but not always, in tuberculosis, and, as a rule, not at all in sarcoma and gumma.

## CHAPTER XXVIII.

### FOREIGN BODIES IN THE UPPER AIR-PASSAGES. RHINOLITHS. ANIMAL PARASITES. SURGICAL INJURIES AND FRACTURES. CICATRICIAL CONTRACTIONS IN THE PHARYNX.

**252. Foreign bodies** get into the nose principally in consequence of mischievous pranks of children. Beads, beans and peas, seeds and kernels, small buttons, paper wads, and similar articles are the most likely objects. Bullets and fragments resulting from an explosion occasionally remain lodged in the nose after perforating the facial bones or migrating with suppurative inflammation. Rarely do solid pieces of food, bits of bone, etc., enter the posterior choanæ by reason of coughing while swallowing or during vomiting. Equivalent to foreign bodies are concretions formed in place, the **rhinoliths.** They are hard bodies, consisting principally of phosphate of calcium. As a rule, they form around a foreign particle as a nucleus, sometimes around a bit of inspissated pus. They occur especially in workmen in cement factories and lime-works. In other instances their origin is obscure. They may be of any size up to that of a plum-kernel or even larger, sometimes smooth and oval, or again of irregular shape and rough. Their color is quite variable.

Foreign bodies are lodged mostly in the inferior nasal meatus, but may be impacted anywhere. Unless smooth and bland, they are rarely tolerated long without causing inflammation, with purulent or seropurulent discharge, sometimes bloody, almost always offensive, and, of course, ordinarily one-sided. Such a discharge should raise a suspicion of foreign body, especially in young children,

in whom suppurative sinuitis is very rare. Granulations are apt to form around the offending substance and may hide it from view. Ulceration, even perforation of the septum, can be caused by sharp-cornered bodies, especially rhinoliths. Under these circumstances distant disturbances, headache, especially one-sided, and even asthma are not uncommon. Nevertheless, foreign bodies have sometimes been endured by patients for years and escaped detection.

The **diagnosis** depends upon feeling the foreign body with the probe. Its removal may require tact, especially when dealing with a child. When recently introduced and not impacted, a foreign body like a button can often be blown out by forcing air through the other nostril, according to Politzer's method of inflation of the ear. If forced back by blowing into the involved side, the substance enters the pharynx and may be swallowed. When this method fails, the simplest way is to grasp the body with stout forceps with scoop-shaped or large perforated blades and to extract it. An unruly child requires narcosis. Good illumination is indispensable. In the case of round, smooth substances, especially when far back in the nose, a spoon-shaped curet is often better than forceps. If the purulent rhinitis does not subside within a few days after extraction, it should be treated according to ¶ 34.

**253.** A special form of foreign bodies, found a number of times in the nose, are **animal parasites**—the maggots of various species of flies, and particularly the screw-worm. They may be present in large numbers and extend into the maxillary and frontal sinuses, causing violent suppurative sinuitis. Their presence causes always much inflammatory reaction and often extensive ulceration. Death from cranial involvement or sepsis has occurred in a noticeable proportion of reported cases. The diagnosis is evident when maggots or worms are found on searching with forceps. It has not always been found possible to remove all parasites mechanically. Probably the least objectionable antiparasitic poison is chloroform vapor

blown through the nostrils, while the patient breathes through the open mouth.

As an exceptional occurrence the intestinal parasitic worms, ascaris or oxyuris, have been found in the nasal cavity and the maxillary sinus.

**254.** Foreign bodies may get into the maxillary sinus through an artificial opening, especially when in the alveolar process. Fragments of surgical instruments, metal cannulæ, remnants of gauze, etc., may maintain suppurative inflammation until removed. If not felt by the probe, when suspected they may be demonstrated by an X-ray photograph, if of a material opaque to those rays.

**255.** In the pharynx sharp foreign bodies get caught when accidentally swallowed or aspirated. Fish-bones and pins are the commonest objects, and they are usually found in the tonsil or impacted in the pyriform sinus between tongue and epiglottis. It is sometimes difficult to see them. When found, they can be grasped by any forceps with broad ends.

**256.** With the exception of **fractures** of the **external nose** surgical injuries extend very rarely into the nose or the pharynx. Although traumatism accounts for a moderate number of septum deformities, its frequency has been much overrated in some books. It is true that violence to the external nose is very common in children, but it cannot break the septum unless it smashes or dislocates the bridge of the nose. This statement is based upon tests on the noses of cadavers by Zuckerkandl, as well as upon his dissections of (united) fractures of the septum. The history of a blow some time ago in the case of a septum deformity is not proof that the latter resulted therefrom, unless the nasal obstruction appeared at once after the accident. Traumatic bleeding from the nose occurs so readily that a fracture cannot be inferred merely on account of epistaxis. Fracture with or without dislocation of the nasal bones can be easily detected soon after the accident, but within a few hours the swell-

ing may be so intense that nothing can be made out. Of course, such extreme swelling is by itself highly suspicious of fracture of the bridge of the nose. If the fracture is complicated by tearing of the mucous surface, gaseous distention—emphysema of the face—may happen when the patient sneezes. The interior of the nose should be promptly examined whenever the bridge is broken. A fracture of the septum involves always the cartilaginous part. The ethmoid perpendicular plate will break only from intense violence; the vomer, never. The line of fracture is usually nearly horizontal, rarely vertical, sometimes multiple. As a rule, the fracture is a simple one with intact mucous membrane. The fragments of the septum may override more or less. There may also be dislocation and lateral displacement of the cartilaginous plate at its junction with the vomer. Occasionally a fracture of the nasal bones causes only bending, but no fracture of the septum. In the bony septum the reunion is ultimately due to callus, while the cartilaginous fragments are merely joined by connective tissue. Unless a broken septum heals with accurate adaptation of the fragments, there will always remain more or less nasal obstruction. Fracture of the nasal bones leaves flattening of the bridge of the nose proportionate to the dislocation of the fragments. Not infrequently disfiguring asymmetry of the external nose results from a break of the bridge and septum.

When the patient is seen before firm union of the fractured bones has taken place, every effort should be made to restore the plane of the septum and the shape of the external nose. Immediate firm tamponing of the nasal passages with gauze has, on the whole, given the best results. The bridge should be lifted from the interior with the largest rod or thickest probes, which can be introduced and the septum straightened in the same manner. Broad forceps, especially the Asch pattern, used in the operation for deflected septum (Fig. 66), may aid in reducing the dislocation of the septal fragments. Narco-

sis should be used if necessary. The nasal passages should then be firmly packed with gauze on both sides, necessitating, of course, mouth-breathing. After a few days the Asch or Meyer rubber tube (¶ 119) may be substituted for the gauze in the lower part of the passage. If the comminution and impaction of the bridge of the nose are such that the normal shape cannot be restored by manipulation, the tendency of modern surgery is to reach the fragments by an external incision—of course, under asepsis—and to retain them in place, if necessary by wiring. In the interior no incisions are ever required. When a faulty union has begun, it is better to await the final (partial) absorption of the callus than to refracture at the time. The later appearances of a fractured septum have been described in ¶ 116.

**257. Cicatricial changes** after ulceration may interfere with the function of the **pharynx** to a variable, sometimes an extreme extent. The most common lesion is adhesion of one or even both posterior pillars to the posterior wall, possibly to an extent separating practically the nasopharynx from the oral pharynx. In other instances the anterior pillars may be so contracted that the palate cannot reach the posterior wall. Scars in the region of the lingual tonsil may narrow the fauces. A variable part of the palate may, besides, have been lost, which, however, is not so common as a mere perforation. Narrowing of the pharynx by cicatricial changes in the posterior wall is less common. In the nasopharynx there may be adhesions between the Eustachian prominence and the posterior wall, bridging over or obliterating the fossa of Rosenmüller. The two Eustachian orifices have been seen united by a transverse bridge.

The most frequent cause of pharyngeal shrinkage is said to be scleroma in those countries where it is prevalent, especially Poland. With us, tertiary syphilis ranks first. Tuberculosis is rare and heals even less frequently. Diphtheria can do much damage in exceptional instances of deep ulceration. Shrinkage from swallowing

caustics is very uncommon. The disturbances may be insignificant in case of moderate deformity, especially after the patient has become accustomed to the annoyance, or they may be extreme and of vital importance. Partial or total shutting-off of the nasopharynx gives the voice a nasal twang and enforces mouth-breathing. If suppuration is started, it persists practically incurable until the patency of the postnasal space is restored. The ears may suffer from persistent exudative catarrh or suppurative otitis. Swallowing is made difficult by any constriction of the fauces or pharynx. In extreme cases starvation threatens. Even breathing may be interfered with to an extent requiring tracheotomy, although this is very exceptional unless the cicatricial shrinkage involves the larynx.

Cicatricial adhesions cannot be prevented during the healing of ulcers spreading over opposed surfaces. It is, of course, worse in neglected cases on account of the extent of the ulceration. The treatment which gives the most and immediate relief is the division of any folds of mucous membrane—for instance, the pillars, which are made tense by the shrinkage without being involved in the cicatrix. When space can be gained by such liberating incisions in healthy tissue, the problem is an easy one. In all other cases treatment is tedious and often unsatisfactory. The division of adhering surfaces does not prevent their ultimate reunion. Plastic operations are rarely possible. Partial success can generally be obtained by persistent dilatation, at first with sponge-tents, later on by means of hard-rubber appliances, sometimes fastened to the teeth according to dental methods. Fuller details can be found in the larger treatises on diseases of the larynx.

## CHAPTER XXIX.

### INFLUENCE OF NASAL AND PHARYNGEAL AFFECTIONS UPON OTHER PARTS OF THE ORGANISM.

**258.** Affections of the nose and pharynx are not rarely the starting-point of disturbances in adjacent organs, or even distant parts of the body. The majority of cases of disease of the middle ear, various ocular troubles, some systemic disturbances, rare instances of pyogenic affections of the brain or its membranes, and quite often certain functional nervous derangements, can be traced etiologically to the upper air-passages. The routes through which nasal or pharyngeal anomalies may involve other organs can be summarized as—

Extension of tumors;

Extension of infection;

Absorption of poisonous products;

Mechanical influences partly exerted through the blood and lymph circulation, partly through impeded breathing;

Nervous or so-called reflex disturbances.

In some of the cases of distant disturbances the exact mode of origin is not entirely clear; in some others nasal anomalies exert their influence through several of the above-mentioned routes. For most purposes, however, this analysis of morbid influences suffices for an understanding of the pathogenesis.

**259.** **Tumors** originating in the nasal passages or accessory sinuses may invade the orbits or extend through the ethmoid or sphenoid bone into the cranial cavity. This is true as well of malignant carcinoma and sarcoma as of benign but encroaching vascular tumors and fibromata. There is, however, not a large number of such occurrences on record.

**260.** The most frequent mode in which nasal affections involve other organs is by **extension of infection.** This is quite rare in an ordinary uncomplicated coryza, rather more likely in the acute rhinitis of influenza or measles, but especially so when a purulent process occurs in nostrils previously stenotic. Less of a menace to the ear, but more so to the orbit and brain, are affections of the sinuses. It is not so much the continued chronic condition which is liable to extend as the subacute exacerbation when a fresh coryza is added. The organ most likely to suffer by extension of nasopharyngeal disease is the ear, in the form of purulent otitis or serous catarrh. The ear is endangered as much by pharyngeal inflammations, even though not suppurative, such as tonsillitis, pharyngitis, or diphtheria, as by purulent processes in the nose itself. Pharyngeal affections are all the more dangerous to the ear if the pharyngeal or faucial tonsils are permanently enlarged. Whether the common plastic form of middle-ear disease (dry catarrh) comes under the head of infection is not known. Acute inflammatory processes in the nose and pharynx are likely to extend likewise into the larynx and bronchial tubes, and if the disease becomes chronic in the upper air-passages, it is also likely to persist in the lower. It is not positively known, however, that disease of the nose may directly lead to involvement of the lungs themselves, and various statements to this effect have not been adequately supported by proof. An occasional complication of chronic purulent disease of the nose is facial erysipelas, sometimes in recurring attacks.

Affections of the tear-passages are, as a rule, due to extension of nasal disease. This is true of hypertrophic inflammation causing stricture, as well as of purulent involvement of the tear-sac. Disease of the frontal sinus and of the ethmoid cells may invade the orbit, causing either a circumscribed abscess or a diffused phlegmon. The eye itself may suffer in the course of purulent rhinitis or affections of the sinuses. Acute

nasal catarrh is often accompanied by an acute conjunctivitis. In what way the deeper structures of the eye may become involved is not clear, but the coincidence of eye disease with purulent nasal affections is often striking, and their relationship apparently confirmed by the results of treatment. Tedious forms of iritis, exudative choroiditis, and atypical subacute chorioretinitis have been seen by the writer, as well as by others in connection with purulent sinus affections on the same side. The writer, too, has seen peripheral palsies of the external ocular muscles occur during exacerbations of purulent nasal conditions (on the same side), and cannot but believe that they were dependent upon the latter. How the infectious material is transported in these obscure instances is not known. In rare cases on record the optic nerves have suffered in the form of neuritis or pressure atrophy in consequence of the upward extension of sphenoid suppuration beyond its confines. Intracranial infections in the form of meningitis and brain abscess have been seen as the consequence of purulent affections of the frontal and sphenoid sinuses and ethmoid cells, very rarely in acute, mostly in chronic, cases. This extension cannot be called a frequent one, although probably many such instances are not correctly interpreted by the general practitioners.

Sinus suppuration leads in rare instances to pyemia or metastatic inflammations in distant parts. This is true also of ordinary tonsillitis. Endocarditis, joint affections, visceral abscesses, have been observed under such circumstances. The relationship of tonsillitis to rheumatism has been discussed in ¶ 232. To what extent tuberculosis of the tonsils—faucial or pharyngeal, certainly not a rare affection—endangers the system by extension is at present an open question.

**261.** Suppurative processes in the nose and accessory cavities may undermine the health by the **absorption of toxins.** The systemic poisoning reveals itself in some instances by a loss of strength and appetite and increas-

ing anemia. It is not improbable that the continued absorption of poisons may account for the neurasthenia often observed in such patients. The swallowing of pus is probably also not wholly indifferent, as the purulent masses are not digested by the action of gastric juice and pass through the stomach with their load of pathogenic or fermentative bacteria. There may be some relation between the dyspepsia often complained of and the swallowing of nasal secretion.

Under the head of absorption of poisonous products may also be included the various forms of toxic palsies occurring subsequent to diphtheria. Statements as to the possibility of such degenerative changes following a simple tonsillitis have in no case been supported by a sufficiently thorough bacteriologic examination of the throat disease.

**262.** A **mechanical influence** upon the system may result from nasal stenosis by reason of the increased positive expiratory and negative inspiratory pressure behind the narrowed region. As an instance of this effect Freudenthal has claimed the frequent coexistence of nasal obstructive lesions with hernia. Mechanical, too, is the production of chest deformities in rickety children in consequence of blockage by postnasal vegetations. A more frequent occurrence is the influence exerted by obstructive, together with acute inflammatory, nasal lesions upon the circulation in adjacent regions. Bilateral nasal obstruction, especially when due to the enlarged pharyngeal tonsil, is often accompanied by mental apathy, inattention, and listlessness, a condition which has been termed aprosexia. It is probable that this depends on circulatory disturbances within the cranial cavity. This may be also the origin of some dull headaches observed under such circumstances. Congestion of the conjunctiva of the eyelids is a very common incident in nasal disease, and in its turn predisposes to secondary local affections like blepharitis. Circulatory disturbances are often revealed by a dusky hued turges-

cence of the eyelids—for instance, in hay fever. Congestion and edema of the Eustachian orifices are common conditions in nasal disease favoring morbid involvement of these passages and of the middle ear.

A variety of disturbances may occur in connection with impeded nasal respiration, such as restlessness during sleep, increasing up to night-terror and nocturnal incontinence of urine. These disturbances depend probably on temporarily insufficient aëration of the blood. They are observed often in children with adenoid vegetations, but occasionally, too, in high degrees of nasal stenosis due to other lesions. Anemia is not rarely dependent on insufficient nasal breathing from adenoids or extreme septum deformities, and improves after a successful operation. In what manner the general malnutrition so often found in children with adenoids is brought about is not entirely clear.

**263.** Certain sequels of nasal and pharyngeal affections which have attracted much attention are the **nervous** or so-called **reflex disturbances.** The term "reflex" is not an appropriate one, for in physiology it signifies the reaction of a nerve center to an impulse reaching it through a sensory nerve, the response being in the form of activity of some centrifugal nerve. Of course, this definition is inapplicable to sensory disturbances, and not quite appropriate to most of the motor phenomena which come under this head, as these are but exceptionally the exaggeration of a normal reflex act. Most of the so-called motor reflexes are really due to a state of morbid excitability induced in the nerve centers by the peripheral stimulus. The author, hence, prefers to call these nervous disturbances (sensory, motor, or vasomotor) "neuroses of peripheral origin"—*i. e.*, of nasal, ocular, etc., origin, as the case may be.

The dependence of a neurosis upon a suspected peripheral lesion can only be proved definitely by a successful therapeutic test. A commonly observed coexistence of peripheral lesion and neurosis may suggest a relationship.

This suspicion may be confirmed by a time relation—for instance, when the nervous disturbances increase whenever the nasal symptoms become more pronounced. The etiologic hypothesis is also favored when the nervous symptoms are one-sided and on the side of the nasal affection. But a definite proof is only furnished when the neurosis ceases promptly after the elimination of the peripheral lesion. Of course, the possibility of an influence by mental suggestion must be taken into account in the case of transitory nervous phenomena. The etiologic proof is all the more positive, however, in those cases in which the cure has been an incomplete one, and in which a relapse of the neurosis coincides with the return of the peripheral affection.

Since these neuroses occur but in small proportion of patients with nasal disease, it is necessary to assume that other factors besides the peripheral lesion are requisite for their production. We must infer an increased sensitiveness or diminished resisting power of the nerve-centers. The nasal lesions may have existed for a long time without nervous disturbances, the latter appearing only after other predisposing conditions had come into play. In some cases this nervous instability is clearly suggested by the patient's previous personal or family history, as a hereditary liability to functional nervous disease can often be elicited. In other cases previous enfeebling influences, sedentary habits, and want of outdoor exercise, long interference with sleep, anxiety, sometimes pregnancy, convalescence from infectious diseases, and especially anemia play an etiologic rôle. But neuroses of peripheral origin may also occur in persons of apparently good health, in whom we must assume an instability of the nervous system without being able to prove it. These disturbances have but a remote connection with hysteria. They may occur in hysteric subjects, but are not particularly frequently observed in them. On the other hand, they may be much exaggerated and diversified by the coexistence of hysteria.

Neuroses of nasal origin are favored by existing disturbances of the stomach and intestines. Not merely are these two conditions often associated, but it can be learned in many instances that aggravation of the intestinal condition increases both the nasal discomfort and the nervous phenomena, while the successful management of dyspepsia or constipation may for the time reduce, or even remove, the neurosis.

Nasal neuroses may be brought on by various nasal lesions. Of the sensory neuroses, especially those of a relatively constant character, the larger part is due to affections of nasal sinuses. In the case of acute severe sinuitis, headaches and neuralgic pains are so constant a phenomenon that they must be considered a direct symptom rather than a superadded neurosis. With sufficient intensity of sinus inflammation every subject will get the same pains, whether he be neurotic or not. But in the case of chronic affections the condition of the nervous system determines the amount and extent of suffering. While in some a chronic sinuitis may cause no pain whatsoever, others of a more neurasthenic type complain at least of periodic attacks, sometimes even of more or less constant spells of neuralgic pains. An important determining factor is the pressure of the pus in the sinus. With retention there is much greater probability of pain than when the flow through the natural orifice is unimpeded.

Most motor neuroses and some sensory disturbances, especially those of periodic type, are due to a different form of nasal disease. They are observed mainly in patients with nasal irritability associated with turgescence of the cavernous tissue. As stated in ¶ 86, the liability to turgescence of the nasal lining is in some instances due to the presence of irritating lesions—viz., small polypi, papillomata, sharp-edged crests on the septum, or foci of suppuration. Quite often there are septum deformities. In such cases any existing reflex nervous disturbances will generally cease after these primary lesions have been

eliminated. But there are many instances in which nasal irritability and vascular turgescence are observed without any other coexisting intranasal anomaly. The condition seems to be the result of previous acute nasal inflammations in persons of a neurotic disposition. This nasal irritability without coexisting other lesions is not rarely the starting-point of neuroses. Their occurrence depends in many such cases on the periodic turgescence of the cavernous tissue, and if this be thoroughly destroyed, the neurosis will cease. Since the galvanocaustic destruction of the enlarged cavernous tissue can put an end to a neurosis, even without the removal of coexisting irritating lesions, Hack, the pioneer in this field, formulated the theory that nasal neuroses depended upon the turgescence of enlarged cavernous tissue. This view has not been upheld in its entire extent by subsequent experience. But it is nevertheless true that neuroses of nasal origin, especially motor neuroses and those of a periodic type, rarely occur except in connection with periodic turgescence of the venous plexus. Neither diffuse hypertrophy of the mucous membrane with relative contraction of the veins nor atrophic processes of the nasal lining lead to neuroses of this type. It is sometimes possible to induce experimentally a transient attack of a neurosis, for instance, headache or asthma by irritation of the mucous membrane with a probe or with chemical irritants. It can be seen in such cases that the intranasal turgescence precedes the nervous disturbances.

**264.** The various forms of neuroses of nasal origin may be summarized under the following heads :

The most typical reflex is **sneezing**, sometimes occurring in fits of distressing duration and accompanied by one-sided, later on even by bilateral, vascular occlusion with serous discharge. The occurrence of this reflex varies considerably with the nervous instability of the patient at different times, and depends, of course, on the occasions for direct provocation, such as drafts, dust, irritant fumes, sometimes idiosyncratic smells. When a

distinct morbid lesion can be found as the starting-point of the irritation, a polypus or a septum crest with sharp edge, sometimes even a fissure in the vestibule, the removal of the lesion often stops the attacks permanently. In other instances the reflex is only relieved, but not entirely controlled, until the overdeveloped cavernous tissue is destroyed by one or more thorough applications of the galvanocaustic burner. Where no irritant lesion can be found, the destruction of the excessive cavernous tissue is the only therapeutic resource. There are, however, rare instances in which this nasal irritability occurs without much accompanying vascular turgescence and without any occlusion, and in such cases no local measures are applicable. The only way of benefiting these patients is by judicious attention to the nervous system or improved climatic environment.

**265.** **Spasmodic cough** is rarely due to nasal lesions, but is not infrequently of pharyngeal origin. It has been observed in connection with hypertrophies in the posterior parts of the nasal passages, especially, however, as a neurosis complicating enlargement of lymphatic tissue, either of the pharyngeal tonsil or of follicles on the posterior walls. Sometimes relatively small, though hypertrophied, faucial tonsils, especially when chronically inflamed, are the starting-point of coughing spells, as can be shown by irritation with the probe. In most of these instances, but by no means in all, the cough is, at least in part, accounted for by a complicating inflammation in the larynx or bronchial tubes. In others the cough is purely a reflex from morbid spots above the larynx. Proper local, especially surgical, measures can remove the cough permanently.

**266.** **Asthma** is in certain instances a neurosis of nasal origin. The frequency of this etiologic relationship has been much overrated by some rhinologists since the days of Hack, but underrated or too often ignored by writers on internal medicine. It must be clearly understood that asthma depends often on pulmonary lesions

(emphysema), cardiac or renal disease, and is in no way connected with the nose. But it is equally positive that there are instances of typical asthmatic attacks which result from nasal anomalies and are permanently cured by their removal. The most frequent and the most definite instances of this kind are those due to nasal polypi. Here a complete removal of the growth stops the attacks, while a return of the polypi brings back the spells of asthma. In other cases the cause is suppurative disease, sometimes of the maxillary sinus, more often of the ethmoid cells. These affections are not cured so quickly, and especially ethmoid disease may prove very rebellious, with corresponding persistence of the asthma. Repeatedly I have seen asthma dependent on spurs on the septum, especially those which touch the middle turbinal toward the rear. Occasionally no structural nasal lesion can be found except enlargement of the cavernous tissue. A cure in such instances depends on the thoroughness with which the enlarged vascular tissue is destroyed. The writer has observed a striking instance of this kind in the person of a physician, a sufferer from periodic asthma since childhood, who submitted to a galvanocaustic burning in 1883. The first operation gave him decided relief as to the frequency and average intensity of the spells. But a continuation of galvanocaustic treatment did not stop the attacks completely for a long while. Fully impressed by the views stated at that time by Hack, the patient submitted in the course of a year to fourteen caustic operations, until the subjective feeling of periodic nasal turgescence had ceased completely, even on exposure to dust and other irritations. Since that time, a period of over fifteen years, the gentleman has been entirely free from asthma.

Hay fever is accompanied very commonly by asthmatic breathing. Properly applied surgical measures often relieve this asthmatic feature markedly, even if they do not prevent hay fever.

The diagnosis of the nasal origin of asthma cannot

always be made with certainty. It is probable when nasal symptoms like occlusion—and less often sneezing fits—directly precede the asthmatic attack. It is made positive when the patient can check the spell by using cocain or suprarenal solution in the nose at the beginning of the attack. But failure of this test does not disprove a nasal origin. There are, indeed, instances in which the nasal symptoms are scarcely noticed by the patient. On the other hand, the rhinologist will meet occasionally with therapeutic failures where there are remediable nasal lesions, especially in cases of long duration. These cases, probably at first a purely nasal neurosis, have become complicated in the course of time by either secondary changes in the nervous system or peripheral lesions like emphysema, which remain after the nasal anomaly is removed.

**267.** The characteristic symptom of the asthmatic attack is difficult inspiration. This is attended by a wheezing sound, audible even at a short distance. There is a feeling of intense oppression over the chest. Expiration, though not normal, is less labored. If not aborted, the attack usually lasts hours. As a rule, the patient has normal breathing between the asthmatic attacks. In severe cases there may be labored breathing continuously for long periods of time, intensified, however, to an agonizing extent during the typical attacks. The spells recur in a very irregular manner. For a time they may return every night. But, as a rule, asthma of nasal origin does not occur so frequently or persistently. Under favorable climatic influences or change of residence it may stay away indefinitely. A mere change from one street to another may have an influence. On the other hand, dust and irritating gases or "idiosyncratic" smells may bring on an attack.

The conditions upon which the impediment to breathing depends have not been definitely demonstrated. Tonic contraction of the diaphragm, spasm of the unstriated muscular fibers in the bronchial walls, conges-

tion of the mucous membrane in the smaller bronchial tubes, have been accused by different writers as the lesions underlying the attack. The writer is inclined to believe that in severe attacks edema of the bronchial tubes probably plays a rôle, since an edematous condition of the nasal mucous membrane can sometimes be demonstrated in such patients.

The *treatment* of asthma will be discussed with reference to the cases of nasal origin only. Where no demonstrable intranasal lesions can be found, and where close questioning elicits no history of nasal turgescence, the case does not come under the care of the rhinologist. In doubtful instances the patient may make the attempt to abort the attack at the beginning by inserting pledgets of cotton with 5 per cent. cocain solution, with or without the addition of suprarenal extract. For permanent purposes cocain should never be given.

For curative purposes the nasal lesion suspected as the starting-point of asthma should be removed surgically. Pronounced septum deflection should be straightened. Lateral crests, especially those which touch the external wall, should be cut off by the use of the saw, trephine, or spoke-shave. Polypi should be removed and suppurative foci properly treated. Where excessive cavernous tissue plays a rôle, it must be destroyed completely by the galvanocautery. Temporary relief may be obtained by inhaling fumes of burning stramonium leaves, especially in the form of the so-called Kidder's pastilles (or Schiffman's powder). Until the cure is completed a change of residence may prove palliative. A trip to the mountains gives immediate relief, sometimes lasting for quite a while.

**268. Nausea** and efforts at **vomiting** are occasionally caused by pharyngeal disease, especially by hypertrophy and chronic inflammation of the lingual tonsil. These disturbances are common, too, in connection with the diffuse hypertrophic pharyngitis seen in smokers and drinkers. In the latter cases the irritated condition of

the lining of the stomach is probably also a determining condition. Nevertheless, local pharyngeal treatment may prove satisfactory, but bad habits must, of course, be corrected.

**Cardiac disturbances,** sometimes irregularities and intermittence of the pulse, more often palpitation (tachycardia), have been observed as the result of hypertrophies of the posterior ends of the turbinals, and have been checked by proper local treatment.

**269.** There are on record a few observations of **exophthalmic goiter** (Graves' or Basedow's disease) which are said to have been cured by the cauterization of intranasal cavernous tissue. These cases were all reported when the first enthusiasm concerning nasal reflexes prevailed, and none have been described since that time.

**Epileptic convulsions** have been referred to a nasal origin in a small number of instances. Many of these cases have been reported after too short a period of time to be considered as satisfactory demonstrations, yet there are a few on record in which a nasal origin seems fairly well established by the permanent cessation of the attacks after nasal treatment. Reflex epileptoid spasm is probably a very rare, though possible, neurosis of nasal origin. The writer has seen an instance of petit mal with laryngeal spasm in an infant, apparently due to a chronic pharyngitis which ceased permanently after the successful treatment of the inflammation by nitrate of silver.

**Chorea** has also been described as an occasional neurosis of nasal or pharyngeal origin. The evidence, however, is not satisfactory. It is entirely improbable that a general chorea should be started in this manner, but it is not unlikely that choreiform twitchings of the eyelids and facial muscles may in some cases depend upon nasal or pharyngeal irritation. While such cases may be benefited gradually by proper local treatment, the therapeutic results are, as a rule, not sufficiently prompt to prove the relationship.

There are on record a few instances of **clonic spasm** of the **facial nerve** cured by intranasal cauterization.

**270.** Numerous sensory disturbances have been described as reflex neuroses of nasal origin. In the case of severe and constant **headache** and **neuralgic pains** accompanying the inflammatory lesions, especially acute suppuration of the sinuses, it seems more logical to classify the pain as a symptom due to radiation of the sensation rather than as a complicating neurosis. Periodic attacks, however, of either headache or of neuralgic pains, can be more properly interpreted as neuroses of nasal origin. In the first publications on this topic, fifteen to eighteen years ago, many instances of such pains were referred to turgescence of the nasal cavernous tissue and apparently cured by its destruction. More recent experience, however, has taught that, as a rule, demonstrable and structural lesions are present in these cases—viz., sinus disease, polypi, or other tumors or septum crests. Thorough search for intranasal lesions and judicious treatment lead to many satisfactory results in obscure forms of headaches and neuralgic pains. The writer's experience has shown him that in some such instances the cause may be found in suppuration at the roof of the pharynx, as well as in the purely nasal lesions.

A form of sensory disturbances, very common in nasal disease, especially in pronounced hypertrophic rhinitis and septum deformities, is **asthenopia**, the inability to use the eyes without itching, burning, smarting, and other uncomfortable or painful sensations. It is doubtful whether this is a purely nervous influence or whether it does not depend in part upon a circulatory disturbance within the eyes. In well-selected cases the therapeutic results of nasal treatment are very satisfactory.

A few extremists have occasionally reported **neurasthenia** as a nasal reflex. This cannot but be considered a misinterpretation. Neurasthenia can undoubtedly be engendered in the long run in predisposed subjects by long-continued suppuration of the nasal accessory cavi-

ties. But this is a toxic rather than a nervous influence. A neurasthenic patient can, moreover, be made worse by any frequently recurring headache due to nasal disease. In such instances nasal treatment may give relief by abolishing the pain and permitting the depressed nervous system to recover, but the alleged direct dependence of neurasthenia upon peripheral irritation is not in accord with any judicious views regarding the nature of neurasthenia.

Although a few reliable cures of asthma by the removal of nasal polypi had previously been reported, the subject of " nasal reflexes " received but little attention until Hack proved its importance. In numerous publications from 1881 up to his death in 1887 he showed the frequency of a variety of neuroses of nasal origin. The fullest details are found in his work, *Ueber die op. Radicalbehandlung bestimmter Formen von Migraine, Asthma, Heufieber*, etc., W. Hack, 1884. At the same time Roe and Daly in this country suggested the nasal origin of hay fever. A flood of publications followed, many of them of uncritical character. Some of the earlier crude ideas and exaggerations have since been refuted, while the better-founded claims have been extensively confirmed. The attention given to nasal reflexes led also to the recognition of the influence of nasal and pharyngeal diseases upon the general health through other routes besides the nervous system.

## PLATE I.

FIG. 1.—Perforating (benign) ulcer of the nasal septum, its edge almost entirely healed.

FIG. 2.—Syphilitic ulceration of the nasal septum, extending toward the rear further than the view; the lower edge of the ulcer is covered with crusts; pus and crusts above the ulcer on the left side (reversed); a broad adhesion between the right middle turbinal and the septum.

FIG. 3.—Turgescence of the cavernous tissue of the rear ends of the (left) inferior and middle turbinals, occluding a nasal passage otherwise structurally normal; the right side is represented after all engorgement has been removed by a cocain spray.

FIG. 4.—Hypertrophy of the mucous membrane of the inferior turbinals as seen in the postnasal mirror. On the right side of the septum there is a polypoid cushion of hypertrophied mucous membrane; the pharyngeal tonsil is enlarged moderately and is not undergoing any marked involution. (From a young man.)

# Plate I.

Fig 1.

Fig. 2.

Fig 3.

Fig. 4.

# *BOOK II.*

# DISEASES OF THE EAR.

# *BOOK II.*

# DISEASES OF THE EAR.

## CHAPTER XXX.

### ANATOMY AND PHYSIOLOGY OF THE EAR.

**271. General Anatomy and Development.**—The auditory organ is divided into the interior, middle, and external ear. The interior ear consists of the terminations of the auditory nerve in the interior of chambers hollowed out in the depth of the petrous bone. This, the apparatus for the perception of sound, is the first part of the ear developed in the embryo and the only part found in the lower vertebrates, especially the fishes. It develops at the side of the hind-brain vesicle in the form of a pit in the epiblast, which, as it sinks in deeper, changes into a vesicle detached from the surface. The auditory nerve, growing out from the brain, enters this vesicle. The latter elongates and divides into two portions—the upper becoming the utriculus, the lower, the sacculus. From the upper extrude hollow ridges which change into the semicircular canals. The lower cavity sends forth a tubular extension, the cochlea. This tube coils in a spiral manner in higher animals, reaching $2\frac{1}{2}$ turns in man. The semicircular canals, of which it is doubtful whether they serve for hearing, exist in all vertebrates, although the lowest fishes have but two. The cochlea, the organ of sound perception, is developed progressively in the animal scale beyond fishes. Semicircular canals and cochlea constitute the labyrinth contained in tunneled-out spaces in the petrous bone. In

the course of embryonic growth these epithelial structures become surrounded by a cartilaginous capsule, which ultimately changes into a thin compact bony shell of characteristic shape imbedded in the cancellated bony tissue of the petrous pyramid. Between the capsule and its epithelial contents a layer of gelatinous embryonic (mesodermal) tissue furnishes the membranous tunics of the labyrinth, while its partial rarefaction leads to the formation of the subsequent lymph-spaces filled with fluid. The acoustic communication between labyrinth and surrounding medium takes place through a membranous window. It is remarkable how very little the interior ear—especially the semicircular canals—varies with the size of the animal.

A middle ear or drum cavity is found in nearly all vertebrates living on land. It consists of an air-space within bony walls separated from the external air by the thin tympanic membrane. The sound vibrations taken up by this membrane are conveyed by a rod of bone or a set of ossicles to the membrane of the labyrinth. The drum cavity communicates with the atmosphere through the Eustachian tube, reaching from tympanum to pharynx. The drum cavity is formed by a recess on the external surface of the petrous part of the temporal bone, which is completed as a closed cavity by articulation with the squamous and tympanic portions of that bone. It develops as a recess from the upper part of the first visceral cleft of the embryo at the same time with the Eustachian passage, which latter from the start communicates with the pharynx. During its formation the tympanic cavity is filled with gelatinous embryonal tissue. The ossicles of the middle ear develop outside and underneath the embryonic drum cavity, as shown in Fig. 85. The hammer and anvil and the bony frame of the drumhead—the annulus tympanicus—are derived from the cartilage formed in the first visceral arch, while that of the second visceral arch furnishes the material for the stapes. These ossicles thus started outside of the skull gradually enter

the tympanic cavity from underneath as its embryonal connective-tissue contents become absorbed.

The external ear consists of the conduit tube leading to the drumhead—the external auditory meatus. The bony part of this passage forms only after birth. In the new-born the external ear consists but of a cartilaginous tube (the external meatus) and its expansion in the form of the auricle. In lower mammals the auricle is

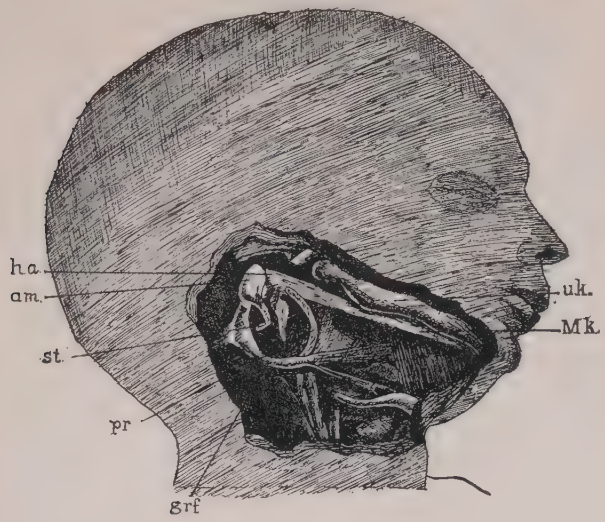



FIG. 85.—Head and neck of a human embryo of eighteen weeks. The visceral skeleton exposed by dissection (Kölliker). The lower jaw is displaced forward in order to show Meckel's cartilage, which can be followed up to the malleus. The drumhead has been removed, and the annulus tympanicus is exposed to view: *h. a*, Malleus; *M. k*, Meckel's cartilage; *u. k*, lower jaw; *am*, anvil; *st*, stapes; *pr*, annulus tympanicus; *grf*, styloid process.

practically a segment of a funnel for catching sound. In man and the higher apes this function is lessened by reason of its less favorable shape.

**272. Surgical Anatomy.**—The auricle is made up of a slightly curved plate of reticulated cartilage, convex on its inner side, its outer surface being convoluted by the ridges and furrows visible externally. The most peripheral posterior ridge is the helix. Inward from it and ap-

proximately parallel with it is the antihelix. The projection in front which represents the outer end of the cartilaginous meatus is the tragus, and opposite to it is the antitragus. The expansion of the meatus between tragus and antitragus is termed the concha. The cartilage is covered by a perichondral membrane. In the pendant lobule of the ear there is no cartilage, the space between the two layers of the skin being filled with fat. The skin is more adherent on the concave side of the auricle than on the convex surface. It contains numerous sebaceous glands, and at the entrance of the auricle are more or less fine or—in elderly men—coarse hairs. Between the cartilaginous ridges there are several small strands of muscular fibers of no significance. The flat muscles which move the auricle in animals are, with rare exceptions, not under the influence of the will in man. They radiate from the junction of auricle and meatus upward and backward and insert themselves partly into the adjoining bony surfaces and partly into the fasciæ. Underneath these muscles the fascia surrounds the junction of auricle and meatus. The principal anchorage of the auricle is, however, maintained by the cartilaginous meatus—the inward prolongation of the auricular cartilage.

**273.** The **external auditory meatus** consists of a cartilaginous tube set into a bony, funnel-shaped conduit (Fig. 86). The entire passage is lined by thin skin, the deeper layer of which serves as periosteum. The cartilaginous portion is not a complete tube, but a thick, tapering gutter open at the upper and posterior side, which gap widens inwardly so that the cartilage tapers at its inner end with a blunt apex at the anterior side. The gap is closed by connective tissue, which becomes continuous with the deeper layer of the skin and the periosteum of the bony part of the channel. The cartilaginous tube is broken into three fragments of nearly equal length by two transverse gaps (incisuræ Santorini), across which there is a membranous junction. This

segmentation permits a moderate displacement when the auricle is pulled upward and backward, and when the articulation of the lower jaw presses against the cartilage on closing the mouth. The cartilaginous portion is about one-third the total length of the meatus. It can be readily separated from the bony canal by dissection, which hence permits in the living a close approach to the drumhead.

In the bony canal we can distinguish four walls continuous with one another. The upper wall is formed by

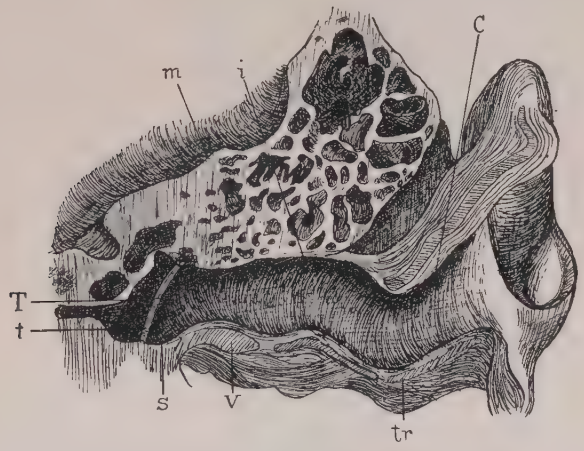



FIG. 86.—Horizontal section through the external meatus; left ear: *C*, Concha; *tr*, tragus; *i*, junction of cartilaginous and bony meatus; *m*, mastoid process; *V*, anterior wall of meatus; *S*, sinus-like pouch adjoining the drumhead; *t*, membrana tympani; *T*, tympanic cavity (Politzer).

the squamous portion of the temporal bone. This consists of two firm plates, of which the upper is the inner surface of the cranial cavity and forms in part the roof of the tympanic cavity. The lower plate separated from the upper by a variable thickness—up to 8 mm.—of cancellated bone extends up to the bony frame, across which the drumhead is stretched external to the drum cavity. The posterior wall separates the meatus from the cells and the antrum of the mastoid process. Superior and posterior walls present a slight concavity. The inferior

wall is moderately thick and compact. The anterior wall, a thin plate of bone, separates the meatus from the articulation of the jaw with the glenoid cavity (Figs. 87 and 88). The anterior and, more so, the inferior wall are distinctly convex. The lower wall, indeed, descends next to the drumhead to such an extent

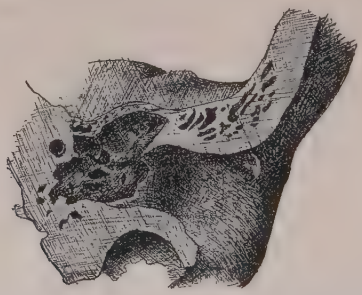


FIG. 87.—Left temporal bone (adult): frontal section through bony meatus and tympanic cavity; posterior half (Zuckerkandl).

FIG. 88.—Left temporal bone at birth. In the infantile bone the squamous plate is nearly vertical, the petrososquamous fissure is still open, and the attic is more developed than the rest of the tympanic cavity (Zuckerkandl).

that a dilatation of the meatus, called the sinus, is formed, in which foreign bodies may lodge.

In the thin skin lining the meatus the sweat-glands are slightly modified and yield a thick, oily secretion, the ear-wax or cerumen. These glands, the orifices of which can be seen by the naked eye, extend throughout the cartilaginous portion, but in the bony part occupy only a narrow sector at the upper posterior wall, reaching nearly to the drumhead.

The meatus is approximately elliptic in cross-section, with its long axis oblique (pointing upward and forward). About 8 to 10 mm. in average diameter, it narrows at the point of greatest convexity of the lower wall near the drumhead,—sometimes to about 5 mm. (transversely),—but dilates again before it reaches the membrana tympani. Along its length it is slightly curved, with convexity upward and backward. This curve is nearly obliterated by forcibly pulling the auricle upward and backward. The average length is about 24 mm., but the anterior and inferior walls exceed the posterior and superior walls by about 5 to 6 mm. in length, so that the plane of the drumhead is quite oblique.

FIG. 89.—Left temporal bone; horizontal section through the bony meatus; upper half (Zuckerkandl).

**274.** The anatomy of the meatus differs considerably at birth from its fully developed condition. The bony meatus is so flattened from above downward that there is scarcely any caliber. There is no bony meatus at the time of birth. The obliquity of the drumhead is much greater than later on. Indeed, the membrane is almost

FIG. 90.—External aspect of the annulus tympanicus; left ear at birth: *a*, tuberculum tympanicum anterior; *p*, tuberculum tympanicum posterior (Zuckerkandl).

horizontal and nearly at the base of the skull. Dissection shows that at birth the membrana tympani is attached to a bony frame in the form of an incomplete ring,—the

annulus tympanicus,—of which an upper segment is wanting (Fig. 90). This bony ring is grooved on its interior, and into this groove the membrane is set. In the new-born the squamous portion of the temporal bone is merely a vertical plate, to the lower edge of which the annulus is attached (Fig. 91). The mastoid process is as yet undeveloped, not projecting and not cancellated. The tympanic bone (annulus) now grows until it constitutes a bony gutter, which ultimately forms the anterior, inferior, and posterior walls of the

FIG. 91.—Left temporal bone of the new-born: *S*, Squamous portion; *u*, its lower part with malar ridge; *a*, annulus tympanicus; *n*, *n*, suture between squamous portion and mastoid extending to *f*, the stylomastoid foramen; *o*, oval window; *r*, round window (Politzer).

meatus. The posterior wall coalesces with the developing mastoid process. The upper wall of the meatus is gradually formed by the growth of the squamous portion in the form of the horizontal plate extending inward from the outer surface of the skull, and in the course of this growth the horizontal position of the drumhead changes ultimately to its more erect plane. About the fourth year of life the ultimate shape of the bony meatus is perfected, and its growth now continues at a diminished rate until a few years after puberty.

**275.** The auricle is supplied by a number of small arterial twigs radiating toward it from the arteries in the neighborhood. Some of these twigs enter the meatus. The venous supply is similar. The muscles of the external ear are supplied by the facial nerve. The sensory nerves are twigs from the auriculotemporal branch of the fifth nerve and the auricularis magnus of the cervical

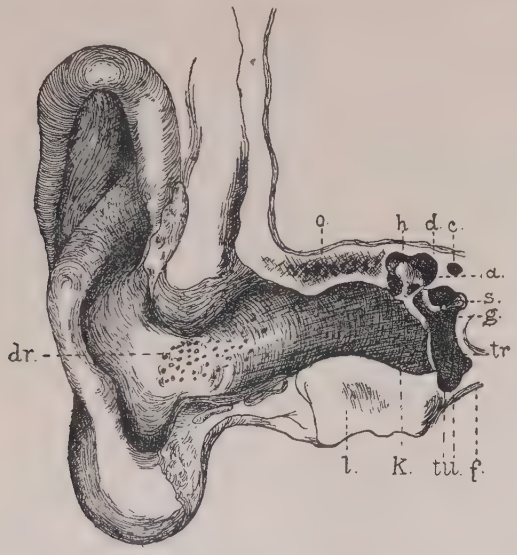



FIG. 92.—Frontal section through the meatus, tympanic membrane, and cavity; right ear: *o*, Pneumatic spaces in the superior wall of the meatus connecting with the middle ear; *d*, roof of the drum cavity; *u*, inferior wall; *t*, drum cavity; *h*, head of malleus; *g*, manubrium; *a*, anvil; *s*, stapes; *c*, cross-section of Fallopian canal; *f*, jugular fossa; *k*, posterior wall of bony meatus; *l*, inferior wall of meatus; *dr*, glandular openings in the external meatus (Politzer).

plexus. Besides these a branch from the pneumogastric nerve supplies the meatus as far as the drumhead.

**276.** The **tympanic cavity** is formed by a niche on the external surface of the petrous bone. It is completed as a closed chamber by the articulation with the squamous part of the temporal bone at the upper external border, with the annulus tympanicus all around, and with the

mastoid process posteriorly. It is an irregular-shaped cavity, flattened in the transverse direction (Fig. 92). The external wall is formed largely by the *membrana tympani* and its bony frame. This thin membrane (0.1 mm. thick) is stretched across the annulus tympanicus, being fastened in the groove on its concavity. About one-seventh part of this bony ring is absent at the upper periphery, and here the drumhead is attached to the margin of a crescentic gap in the squamous portion—Rivini's incisure. This extra-annular area of the drumhead is called the flaccid portion, or Shrapnell's membrane. The drumhead consists of thin true skin on its outer side, delicate mucous membrane on the tympanic side, with a double layer of connective-tissue fibers between. The fibers are arranged radially in the external layer and in concentric circles in the inner layer. This fibrous layer, to which the membrane owes its firmness, is wanting in the flaccid portion. At its insertion in the groove of the bony ring the fibrous layer is thickened in the form of a *tendinous* ring (Fig. 92). The membrane is grayish and translucent.

The plane of the drumhead is not vertical, but slants downward and inward and forward and inward. In an imperfect view through the meatus it seems to be nearly the continuation of the posterior upper wall of the meatus. The membrane, however, does not lie in a single plane, but has a peculiar curvature which can be artificially imitated in the following way: If a flexible but plastic membrane (moist bladder) is stretched across the wide mouth of a bottle and pressed down in its center by an impinging rod, the membrane becomes conic, with its apex toward the interior, while each radius from periphery to center assumes a curve with convexity outward. This shape has been proved, both by trial as well as mathematically, to be the most favorable for the reception of sound-waves. The shape of the drumhead is even more complicated, because the traction is not merely exerted at its center, but from the center to nearly the upper periphery

by the linear attachment of the handle of the hammer. The handle of the hammer is oblique with reference to all axes of the head, its lower end pointing inward at an angle of 35 degrees, and also slightly backward as com-

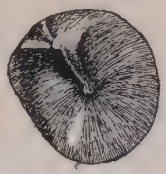


FIG. 93.—Normal membrana tympani (left), enlarged.

pared with its upper end. The tympanic cavity is narrowed to about 2.5 mm. at the level of the center of the drumhead, by reason of this inward depression.

The attachment of the hammer divides the drumhead

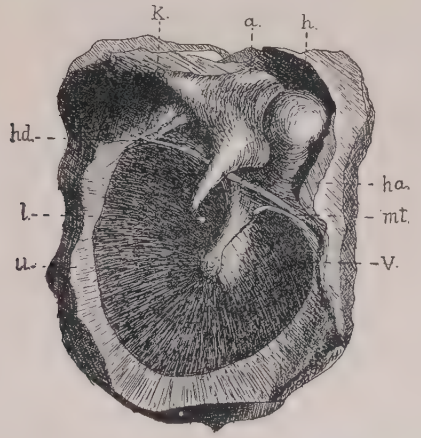



FIG. 94.—Inner surface of the left membrana tympani enlarged: *h*, Head of malleus; *ha*, neck of malleus; *mt*, tendon of the tensor tympani muscle and anterior fold of the drumhead; *u*, inferior end of the manubrium; *v*, anterior half of the drumhead; *hd*, posterior fold of the drumhead and chorda tympani nerve; *a*, anvil; *K*, its short process; *l*, its long process (Politzer).

into an (smaller) anterior and (larger) posterior half. The prominence of the upper end of the handle (or short process) causes the appearance of an anterior and a posterior fold radiating peripherally from this sharp point.

These "creases" are exaggerated when the membrane is morbidly retracted. On the internal surface of the membrana tympani the handle of the hammer is seen attached along its entire length—from its projecting neck to its flattened lower end (Fig. 94). At the lever of its upper insertion into the drumhead the mucous membrane is raised in the form of two folds or ridges—the more prominent posterior and the lesser developed anterior fold—extending to the bony margin. They correspond nearly in site with the projecting creases marked on the external surface. These duplicatures of mucous membrane form pockets with the flaccid portion of the membrane. The chorda tympani nerve, which leaves the facial nerve at the upper end of the Fallopian canal, passes across the membrana tympani along this fold or ridge to the Glaserian fissure in front and above, where it emerges from the drum cavity.

The area of the membrana tympani is an ellipse, with its long axis tilted slightly forward, the long diameter being about 10 mm., the short diameter about 9 mm. At the upper margin the flaccid portion extends slightly beyond the elliptic outline.

**277.** The floor of the tympanic cavity is 2 to 3 mm. below the level of the inferior margin of the membrane. Above the upper margin of the drumhead the cavity extends upward 5 to 6 mm., being slightly higher behind than in front. This upper space is known as the attic (Fig. 95). The external wall of the attic is furnished by the up-turned lower plate of the squamous part of the temporal bone. The upper or cerebral plate of its horizontal portion projects slightly inward and helps to form the roof of the drum cavity, being overlapped by a lamella from the petrous bone. Through the suture between the squamous and petrous parts there extends a vascular process from the dura mater in childhood, which obliterates later on. At the upper front corner of the suture between petrous and tympanic portion a chink is left in the bone,—the Glaserian fissure,—through which

the chorda tympani nerve leaves the drum cavity. The narrow roof of the drum cavity slants downward and forward. It consists usually of cancellated bone 2 to 3 mm. thick, but may be reduced to a thin plate, which is sometimes defective, permitting contact between the dura and tympanic mucous membrane.

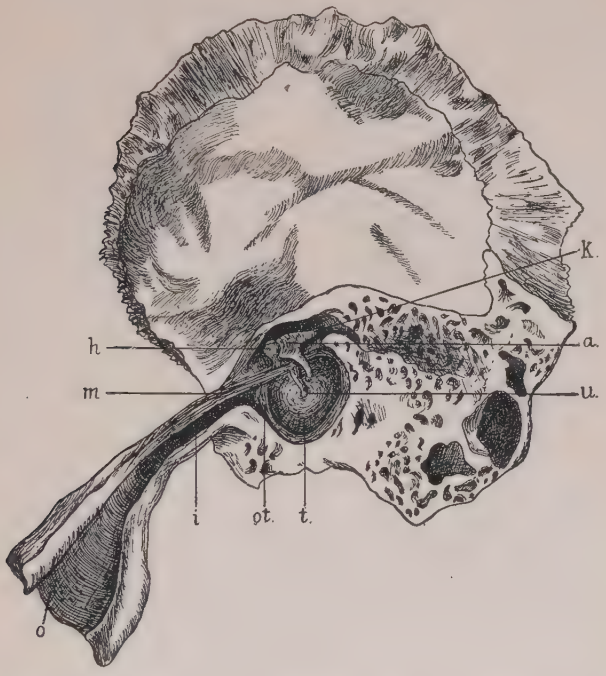



FIG. 95.—Eustachian tube and tympanic cavity in connection: *t*, Membrana tympani; *h*, head of malleus; *u*, lower end of the handle of the hammer; *a*, body of the incus; *K*, short process of the incus; *m*, tensor tympani muscle; *o*, pharyngeal end of the Eustachian tube; *i*, isthmus of the Eustachian tube; *ot*, tympanic opening of the Eustachian tube; right ear (Politzer).

The posterior wall is represented below by a narrow curved gutter formed by the junction of external and internal walls. It widens upward, and, at the level of the upper margin of the drumhead, an opening leads into the mastoid antrum. This—the aditus—is of triangular shape, with base upward. Underneath it is a conic pro-

jection, the eminentia pyramidalis. In a tunnel in its interior the short pear-shaped stapedius muscle is attached and hidden, only its tendon emerging from the hole at the apex. The inferior wall, narrower than the superior, presents a roughened surface. Underneath it is the bulb of the jugular vein. This wall is of variable thickness, sometimes partially defective. The anterior boundary of the tympanic cavity is formed by the forward slant of the internal wall. Outside of it (anteriorly) is the canal of the carotid artery. Below the level of the upper part of the membrana tympani is the opening into the Eustachian tube, of funnel shape and without sharp boundary between drum cavity and tube. It is about 3.5 mm. wide and 4.5 mm. high. Above the Eustachian tube and parallel with it is a narrow bony canal for the tensor tympani muscle.

The internal wall, a thin but firm plate of bone, separates the drum cavity from the labyrinth. Its center is marked by a prominence—the *promontory* formed by the projection of the first turn of the cochlea. Above and behind the promontory is the *oval window*, 4 mm. in its transverse, 1.5 mm. in its vertical, diameter. It is the opening into the vestibule and is closed by the foot-plate of the stapes. The plane of this window slants downward and inward. It is set deeply in a niche into which the foot-plate of the stirrup fits. About 3 to 4 mm. below the oval window, and hence below and behind the promontory, is the smaller round or triangular window which leads into the cochlea. It is closed by a membrane, the membrana secundaria. The facial nerve coming from the interior passes in a curve over the vestibule and thence runs in the slightly projecting Fallopian canal (sometimes a mere groove), with a concave turn above and behind the oval window. The canal pursues its visible course downward at the junction of internal and posterior wall, and through it the facial nerve reaches its exit through the stylomastoid foramen (Fig. 96).

**278.** The tympanic cavity is lined by a delicate mucous membrane containing few mucous glands. The epithelium is ciliated, cylindric in the lower, but flattened in the upper, areas. The deeper layer of mucous membrane serves as periosteum. The membrane follows the surface accurately, but is raised in the form of the reduplications or folds across the upper part of the drumhead, while several inconstant folds are usually found between the walls and the upper part of the ossicles. The mucous membrane lines the ossicles as well as their

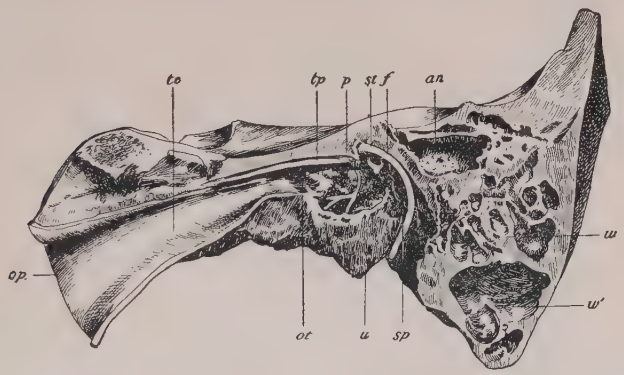



FIG. 96.—Sagittal section through the entire middle ear of the adult, inner half of left ear: *op*, Pharyngeal end of Eustachian tube; *ot*, tympanic opening of Eustachian tube; *te*, Eustachian tube; *tp*, tensor tympani muscle; *p*, promontory with Jacobson's nerve across it; *u*, inferior tympanic wall; *st*, stapes; *sp*, stapedius muscle; *f*, facial nerve; *an*, mastoid antrum; *w*, *w'*, mastoid cells (Politzer).

various ligaments. It is continuous with the lining of the mastoid antrum and that of the Eustachian tube.

The ossicles, three in number, form a bony chain from drumhead to oval window. The hammer or malleus has a club-shaped head with an articulating surface for the anvil. The tapering neck has a projecting knob, the short process, inserted at the upper end of the drumhead, from which the handle or manubrium descends at an obtuse angle, terminating in a flattened end. The point of attachment of this end near the middle of the drum-

head is termed the umbo. From the neck of the hammer a slender bony process—the long process—ex-

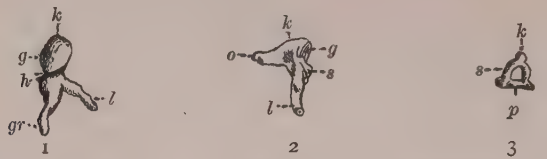



FIG. 97.—The ossicles of the middle ear: 1, The malleus: *k*, head; *h*, neck; *gr*, manubrium; *l*, long process; *g*, articular surface. 2, The incus: *k*, body; *o*, short process; *l*, long process; *g*, articular surface; *s*, cog beneath the articulation. 3, The stapes: *k*, articulating head; *S*, crus stapedii; *p*, foot-plate (Politzer).

tends forward to the Glaserian fissure (Fig. 97). The anvil or incus resembles in shape a molar tooth with two roots. Its articulating surface, like that of the hammer, is saddle-shaped. The long process descends slantingly inward and somewhat posteriorly, and is attached to the stapes. The horizontal short process points into the mastoid aditus. The stirrup or stapes has the exact shape indicated by its name. Its head, a detached button of bone, articulates with the long process of the anvil, while the foot-plate fits into the oval window. Between head and foot-plate are the two *crura*. The articulations between hammer and anvil and anvil and stirrup are true joints with minute plates of cartilage and capsular ligaments. The foot-plate of the stirrup is attached to the margin of the oval window by an encompassing annular ligament. While

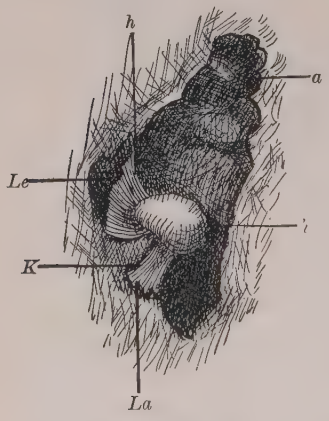



FIG. 98.—Tympanic cavity exposed by removal of the roof, showing the ligaments of the ossicles: *h*, *h*, Head of the malleus; *La*, ligament. mallei ant.; *Le*, ligament. mallei ext.; *K*, projecting spina tymp. post.; *a*, mastoid antrum (Politzer).

the chain of ossicles is held in place by the attachment to the drumhead and oval window, the ossicles are steadied besides by additional ligaments. A short superior ligament suspends the head of the hammer from the roof. A fan-shaped band springing from the neck of the hammer inserts itself into the margin of the incisure of Rivini (Fig. 98). A similar narrow one attaches itself forward along the upper anterior corner of the drum cavity. This anterior ligament, together with the extreme posterior portion of the external ligament, forms the axial cord around which the hammer can vibrate. The short process of the anvil is also steadied by a small ligament coming from the upper posterior tympanic wall. The tensor tympani muscle, a thin slender muscle, originates from the walls of the narrow canal in the bone, above and parallel to the Eustachian tube. Its tendon, traversing the upper part of the tympanic cavity from the anterior internal corner to the hammer, attaches itself at the junction of neck and handle. It pulls the handle inward. The stapedius muscle originates and is concealed in the tunnel in the eminentia pyramidalis at the lower internal portion of the posterior wall. Its tendon issues through the minute hole in the eminentia, and reaches the head of the stapes, which it can deflect slightly backward and downward.

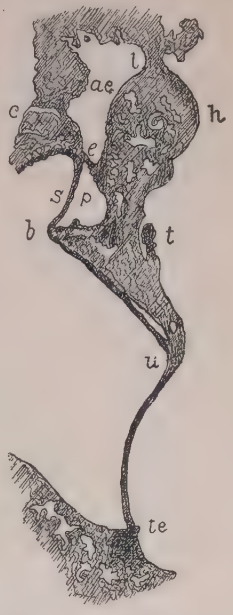



FIG. 99. — Microscopic section through hammer, drumhead, and external part of the attic: *h*, Head of the hammer; *te*, tendinous insertion of the membrana tympani; *b*, short process of the hammer; *u*, umbo; *t*, transverse section of chorda tympani nerve; *e*, external ligament of hammer; *l*, superior ligament; *s*, Shrapnell's membrane; *ae*, external attic; *p*, Prussak's space; *c*, a vascular channel between attic and bony meatus (Politzer).

**279.** The ligaments of the ossicles, together with some irregular and inconstant bridges of mucous membrane, subdivide the attic into a series of minute chambers (Fig. 99). The most constant of these are Prussak's space, between Shrapnell's membrane, short process of hammer and external ligament, and the external part of the attic between the external wall above the drumhead and the head of the hammer. All these spaces communicate normally with the tympanic cavity through minute orifices. It is easy to see how readily inflammatory action may lead to occlusion of these spaces and retention of secretion. The irregular and inconstant arrangement of bridges of mucous membrane from the walls of the attic to the heads of the ossicles has an embryologic reason. Until shortly before birth the drum cavity is filled with embryonic connective tissue, which then undergoes absorption and transformation into thin mucous membrane lining all the contents of the cavity.

**280.** It is important for surgical purposes to be able to locate the tympanic contents with reference to the membrana tympani. It must be remembered that the plane of the drumhead slants obliquely forward and inward as well as downward and inward. On account of the curvature of the membrane the area above the umbo and the handle of the hammer is at an angle of about 35 degrees with the vertical, while the inferior part of the drumhead is more nearly vertical. By the imaginary downward prolongation of the handle of the malleus and an imaginary horizontal line through the umbo the membrane is divided into four quadrants. In the case of large perforation or total loss of the membrane various parts of the tympanic cavity can be seen during life, although the visible field depends considerably on the varying size and curvature of the meatus (Fig. 100). The anterior upper quadrant does not quite permit a view of the Eustachian orifice. The tendon of the tensor tympani muscle, barely visible, is, however, accessible to the knife. Through the posterior inferior quadrant the promontory

and often the round window are visible. The posterior upper fourth of the membrane, if absent, permits a view of the long process of the anvil, its articulation with the head of the stapes, the posterior crus of the stapes, and the tendon of the stapedius muscle. The chorda tympani, sometimes visible at the upper margin of the membrane as a transverse filament, can be reached and injured by instruments. The facial nerve in its canal is not endangered by the ordinary intratympanic manipulations, but must be carefully avoided in resection of the posterior wall of the meatus.

**281.** The Eustachian tube, about 3.5 cm. long, passes

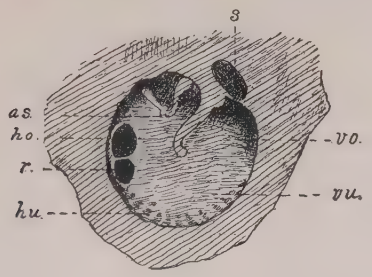



FIG. 100.—Topographic relation of drumhead to the internal tympanic wall (schematic): *vo*, Anterior upper quadrant; *vu*, anterior lower quadrant; *ho*, posterior upper quadrant; *hu*, posterior lower quadrant; *as*, articulation of anvil and stapes; *r*, round window; *s*, Shrapnell's membrane (Politzer).

obliquely downward, forward, and inward from the upper part of the anterior wall of the tympanic cavity to the side of the pharynx (compare Figs. 95 and 96). Its upper third is formed by the incomplete bony canal in the petrous bone, completed partly by the tympanic portion externally and the sphenoid wing in front and above. There is a gradual transition from tympanic cavity to the Eustachian canal. Thence on the bony passage narrows until near its end—the so-called isthmus—it is but 2 mm. high and 1 mm. wide. The lower two-thirds of the tube—the cartilaginous portion—expands in the opposite direction up to the pharyngeal orifice, which shows a height of 9 mm. by a width of 5 mm. The principal

structure of its wall is the triangular plate of cartilage which forms the median wall. By curving at its upper border in the form of a hook it forms also the roof of the tube (Fig. 101). The external wall and floor of the tube are membranous. The Eustachian cartilage is about 12 mm. high and 5 mm. thick at its pharyngeal end. In its length of 25 mm. it tapers toward the rear to a height of 7 mm. and a thickness of about 2 mm. The bony

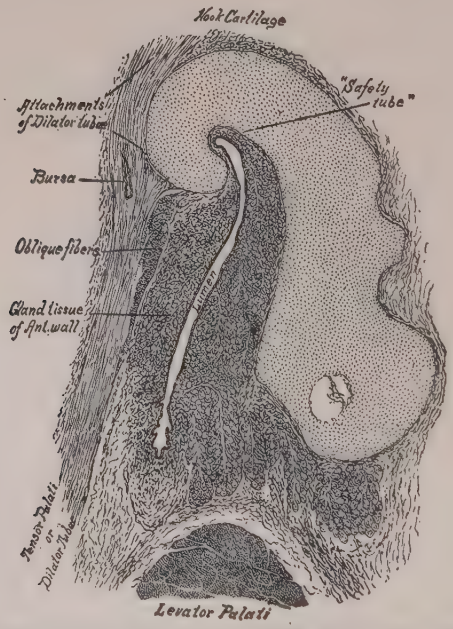



FIG. 101.—Vertical section through the middle third of the Eustachian tube, showing the tubopalatal muscles (Randall).

canal expands again beyond the isthmus (inward) and the cartilaginous plate is set into this opening. Its upper border is fastened in a groove between petrous bone and sphenoid wing. It is, furthermore, strengthened by a lamella from the basilar fibrocartilage. The projection of the Eustachian cartilage into the pharynx forms the prominent posterior lip of the Eustachian orifice—the Eustachian tumefaction—the mucous membrane over

which is thickened by an adenoid cushion. The orifice itself is a funnel-shaped niche surrounded by a triangular or oval frame, formed by folds of mucous membrane (Fig. 102). Posterior to it and above it is the fossa of Rosenmüller. The pharyngeal mucous membrane is continuous with that of the tube, in which channel, however, it is puckered in the form of longitudinal folds. The

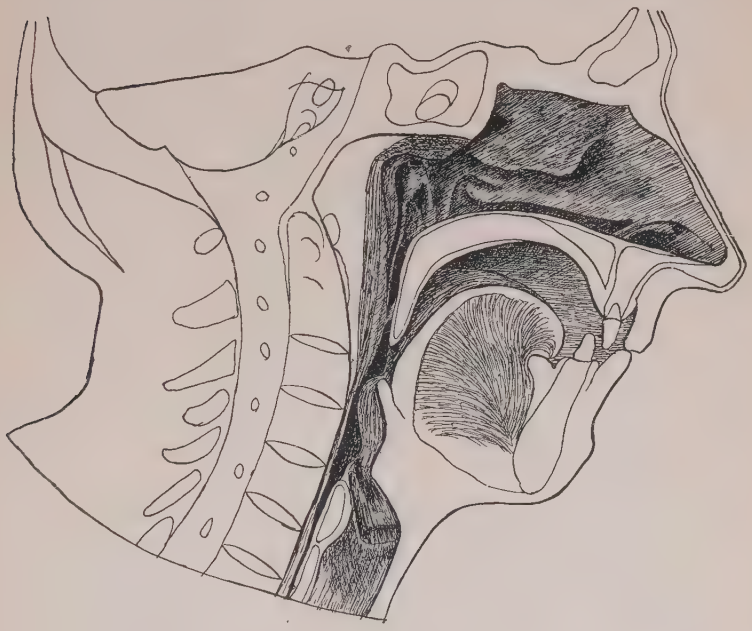


FIG. 102.—Sagittal section of frozen head; left head; exact representation of Eustachian orifice and surroundings (Zuckerkandl).

outer wall of the tube is formed only by mucous membrane strengthened by fibrous tissue and thickened toward its upper end by a cushion of fat. The mucous membrane continues throughout the bony part as a more delicate lining, and is continuous with that of the drum cavity. The pharyngeal orifice in the adult is at the level of the posterior end of the inferior turbinal. At birth its level is scarcely above that of the palate, while

the entire tube at that time is relatively much shorter than later in life.

The caliber of the Eustachian tube forms a somewhat S-shaped slit throughout the cartilaginous portion, the walls of which are in actual contact. In the bony portion the caliber, though much smaller, is patent. Gaping of the passage occurs only during the act of swallowing, and in some persons while yawning. The dilatation of the tube is due to the action of two muscles, the levator palati and the tensor palati. The former arises from the petrous bone and runs parallel to and underneath the floor of the Eustachian tube to the soft palate. During its contraction its thickening raises the floor of the tube. The tensor palati muscle is attached to the inferior surface of the sphenoid wing—to the lower lateral end of the hook-shaped cartilaginous roof of the tube, as well as to its external membranous wall. Descending obliquely it winds itself around the pterygoid hamulus and inserts itself into the fibrous expansion of the hard palate. By its action it unrolls the curved roof and pulls outward the external wall of the Eustachian tube, thereby permitting its gaping. It has hence been termed the *abductor* or *dilator tubæ*.

**282.** The tympanic cavity communicates toward the rear with the cavity in the mastoid process—the mastoid antrum—and the adjoining cells. In the upper part of the posterior wall there is a triangular opening, with base up,—the aditus,—through which the tympanic attic is continuous with the mastoid antrum. The latter, an irregular shaped cavity of variable size, at the level of the attic and behind the tympanic cavity, is surrounded by smaller air-cells in the mastoid process and often communicates with air-spaces in the petrous bone; sometimes even with recesses in the occipital bone. The extent of these pneumatic spaces is especially well seen in casts made by corrosion (Fig. 103).

The mastoid process, essentially a part of the petrous portion, is covered in front and to some extent externally

by the squamous part of the temporal bone, which also forms in part the roof of the antrum. Between squamous and petrous portions is the mastoid fissure, which obliterates gradually during childhood. The anterior boundary is the posterior wall of the meatus. Externally it is covered by thick, tough skin firmly united with the aponeurosis and the periosteum. At its lower tip the surface is roughened for the attachment of the sterno-

FIG. 103.—Cast of the Eustachian tube, tympanic cavity, mastoid antrum, and some mastoid cells posterior to the antrum, viewed from the external side: 1, Incomplete cast of a cell between tube and anterior tympanic cavity; 2, cellular dilatation in the tympanic roof; 3, transverse incisure anterior to the aditus; 4, cavity in which the heads of hammer and anvil were lodged; 5, site of short process of anvil; 6, rear end of antrum; 7, transitional cell; 8, terminal cell (Bezold).

cleidomastoid muscle. In its interior the mastoid process is made up either of large pneumatic cells (about one-third of all instances) or of firm cancellated bone (about one-fifth of all subjects), or both types of bony structure are represented to a variable extent. The larger cells are continuous with the antrum through narrow orifices and are lined by thin mucous membrane. Smaller cells are not pneumatic, but contain medullary

FIG. 104.—Mastoid process opened, with large pneumatic spaces (Politzer).

FIG. 105.—Mastoid process consisting of dense bone (Politzer).

contents. In less common instances, but especially in pathologic cases, the bony shell may be quite hard, even

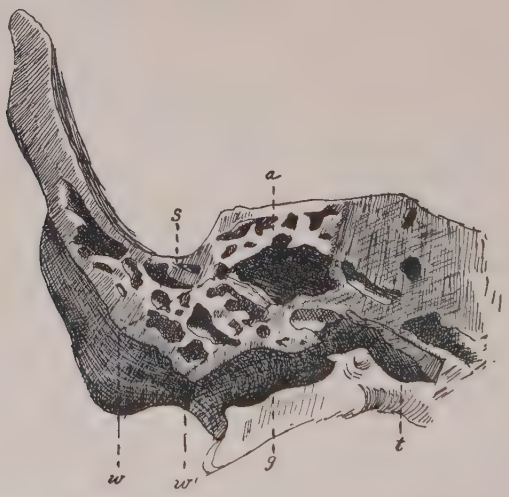



FIG. 106.—Horizontal section through mastoid process with large pneumatic cells (seen from above): *t*, Tympanic cavity; *g*, posterior wall of meatus; *a*, mastoid antrum; *S*, lateral sinus; *w*, *w'*, external field of operation in opening into the mastoid antrum (Politzer).

sclerotic (Figs. 104 and 105). The roof of the antrum is usually but a thin plate of bone, sometimes partially de-

ficient. Of great surgical importance is the relation of the antrum to the lateral venous (or transverse) sinus. This venous channel runs in a groove (sigmoid fossa) in the bone, passing downward and forward along the internal surface of the squamous portion, and then, with a sharp bend behind and partly above the antrum, it turns forward and inward along the posterior surface of the petrous pyramid to reach the jugular foramen. The bony groove in the cerebral plate projects into the antrum at its upper posterior corner—the variable extent of which cannot be predicted from external inspection

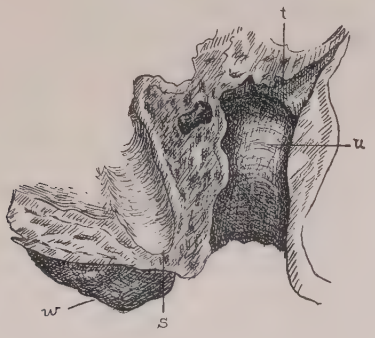



FIG. 107.—Horizontal section (seen from above) through the temporal bone; mastoid process of relatively dense bone: *t*, Tympanic cavity; *u*, inferior wall of external meatus; *s*, groove for lateral sinus; *w*, external surface of the mastoid process (Politzer).

(Figs. 106 and 107). It is generally a little lower on the right side than on the left. It is more apt to encroach upon the antrum when the bone is diploetic than when it is pneumatic. In operating upon the mastoid the surgeon must, hence, be prepared to encounter and to avoid the lateral sinus. Suppurative inflammation of the mastoid antrum can readily involve the lateral sinus or extend through the thin roof into the cranial cavity. The distance of the antrum from the external surface of the bone is about 12 to 14 mm. A direct route to it is obtained by drilling immediately behind the auditory meatus parallel with its posterior upper wall.

**283.** The mastoid process is but a flat, undeveloped, and hence scarcely prominent plate at birth. The cavity of the antrum is present, but is covered merely by a thin shell of bone without pneumatic spaces. It is hence easily reached by operation. The roof, on the other hand, is relatively thick, so that during early infancy there is less liability to cerebral extension of mastoid disease.

**284.** The middle ear is well supplied with numerous small arteries and veins entering from various directions. None of them are of sufficient size to require detailed description for surgical purposes. Through Shrapnell's membrane the tympanic vessels anastomose with those of the meatus, while connecting branches between drum cavity and the internal ear penetrate through the labyrinthine wall. The membrana tympani has a small artery with a vein descending along the handle of the hammer. Between these vessels and the periphery there exist branches running radially. The cutaneous and the mucous layers of the drumhead have each a separate set of vessels, which, however, anastomose. The sensory nerves of the drum cavity are derived partly from the trigeminus, mainly from the glossopharyngeus. There are also fibers from the sympathetic nerves. The largest nerve-branches are found on the internal wall of the cavity. The facial nerve gives off two branches in the Fallopian canal—viz., one for the stapedius muscle and the chorda tympani, which ascends along the posterior wall and then traverses the drum between the neck of the hammer and the anvil along the folds on the inner surface of the drumhead.

**285.** The **internal ear** or **labyrinth** is situated in passages tunneled out in the interior of the petrous bone. In the adult the surrounding bony substance differs so little in consistency from the capsule of the labyrinth that its demonstration by dissection is very difficult. But in the new-born the spongy bone substance can be removed more easily, leaving the bony labyrinth. This consists

of vestibule, cochlea, and semicircular canals. The vestibule is an irregular elliptic cavity, inward from the tympanum, with which it connects through the oval window (closed by the stapes). A vertical crest on its

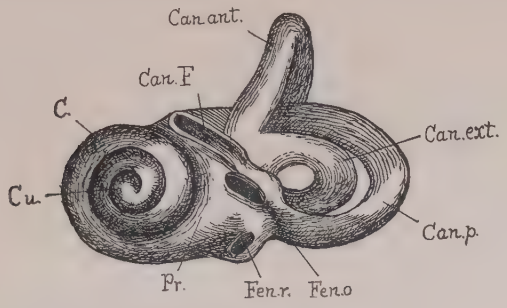



FIG. 108.—Left bony labyrinth seen from the external side and somewhat from below (enlarged): *Can. F*, Fallopian canal; *C*, cochlea; *Cu*, cupola; *Pr*, promontory; *Fen. r*, round window; *Fen. o*, oval window (Gegenbaur).

internal wall divides the vestibule into an anterior spheric and the posterior elliptic recess (Fig. 108). Downward and forward it is prolonged into the cochlea, a slightly tapering tube coiled upon itself like a snail, with $2\frac{1}{2}$

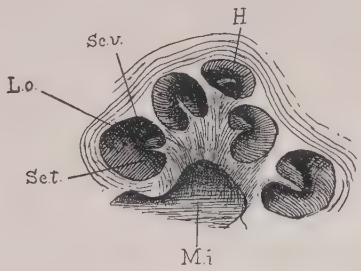



FIG. 109.—Section through the cochlea (enlarged): *H*, Hamulus; *Sc.v*, scala vestibuli; *Sc.t*, scala tympani; *L.o*, lamina spiralis ossea; *M.i*, internal auditory meatus (Gegenbaur).

turns, the terminal coil or cupola being in front. The beginning of the cochlea causes the bulging of the internal tympanic wall, known as the promontory. In the axis of the cochlea bony trabeculæ form the spindle

or modiolus, a conic axis with a screw-shaped lamina projecting into the coils and reaching half-way across them. This **osseous lamina spiralis** is completed by a membranous extension across the cochlear passage which divides the channel into an upper half, the **scala vestibuli,** and the inferior half, the **scala tympani** (Fig. 109). This partition does not quite reach to the end of the cupola, where the two scalæ communicate. The scala vestibuli is continuous with the interior of the vestibule. The scala tympani, however, is closed at its vestibular end by the spiral partition wall. Through the round or triangular window it is in communication with the drum cavity. The membranous partition in the cochlear passage consists, however, of two layers, between which a third channel, the cochlear duct, is left, which follows the convolution of the bony tube from vestibule to cupola.

On the posterior side of the vestibule the three semicircular canals constitute three tunnels in the bone, lying in three planes all vertical to each other. Their planes do not strictly coincide with any normal plane of the head. The anterior or superior semicircular canal lies nearly in the frontal plane. The internal or posterior or inferior vertical semicircular, the longest and narrowest of the three, lies approximately in the sagittal plane, while the external semicircular canal, the shortest and thickest, is about horizontal, with its vertex toward the rear. It projects slightly into the drum cavity behind the Fallopian canal. The external ends of the semicircular canals expand in the form of the ampullæ, while the insertion of their other end into the vestibule has the same caliber as the canal itself. The superior and the posterior semicircular canal unite with each other at their junction with the vestibule.

**286.** The auditory and facial nerves enter the petrous pyramid near the middle of its posterior surface, through the **internal auditory meatus.** This short canal, passing outward and somewhat backward, enlarges into a pouch inward from the vestibule. Here the facial nerve sepa-

rates and enters the Fallopian canal, passing over the vestibule in the form of a sharp bend, whence it pursues its curved course toward the rear and downward. The auditory nerve, however, divides into its branches, two to the vestibule and one to the cochlea, which latter enters partly direct at the vestibular end, partly gradually through the spindle, in which it pursues a spiral course. In this spiral passage the nerve becomes gangliform by the addition of nerve-cells. Its fibers pass in a comb-shaped fashion through fine perforations in the lamina spiralis into the cochlear duct.

**287.** The membranous labyrinth is in the interior of the bony chambers. While its shape resembles that of the bony labyrinth, it does not form an accurate lining for the latter. Between the bony walls and the membranous labyrinth there is a lymph-space filled with a fluid, known as the perilymph. The bony labyrinth is lined by a delicate periosteum with endothelial cells. The interior of the membranous labyrinth is also filled with a fluid—the endolymph. The perilymphatic space communicates with the subarachnoid space of the brain through the cochlear aqueduct. The latter, a fine membranous tube, passes from the closed end of the scala tympani through the petrous pyramid to its lower posterior margin, where it becomes continuous with the meninges. A similar passage, the vestibular aqueduct, puts the endolymph into communication with the cerebral lymph-spaces. It begins in the form of two minute passages from the membranous sacs in the vestibule,—one from the utriculus, the other from the sacculus,—which unite, pass through the pyramid, and empty into the *cistern* on the middle of its posterior surface. This latter small closed bag communicates probably through microscopic channels with the subdural space (Fig. 110).

**288.** The interior of the vestibule contains two membranous pouches, the utriculus and the sacculus, which communicate with each other only through the branches of the forked vestibular aqueduct. The posterior of

these bags, the utricle, much smaller than the vestibule, is attached to its internal surface. It is continuous with the membranous semicircular canals. These tubes line the bony ampullæ, but contract in the bony semicircular canals to the tubules much smaller than the bony tunnels. They are fastened along the convex wall and steadied by transverse bands. All these membranous passages are lined by flat epithelium. In the utricles and in the ampullæ the wall is thickened in spots, termed maculæ, where the epithelium changes into cylindric cells with long cilia. These hair-like processes are covered with a sticky, jelly-like substance, in which crystals or carbonate

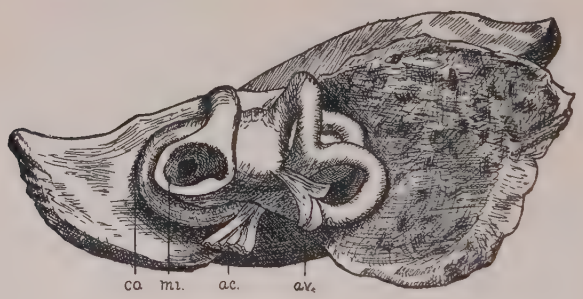



FIG. 110.—Rear view of the bony labyrinth at birth (enlarged): *co*, Cochlea; *mi*, internal meatus auditorius; *ac*, aquæductus cochleæ; *av*, aquæductus vestibuli (Politzer).

of lime—the otoliths—are suspended. As these ciliated cells are supplied by nerve-fibers they are considered the sensory terminations of the nerve.

The sacculus, the smaller and anterior of the vestibular pouches, is fastened likewise to the internal wall of the vestibule. Its structure and interior are similar to those of the utricle. Through a very fine tubule it communicates with the cochlear duct, which latter apparently terminates at the cochlear end of the vestibule in a blind cul-de-sac.

**289.** The cochlear duct is the most complicated of all labyrinthine structures (Figs. 111 and 112). This spirally

wound passage is triangular in cross-section. Its wall next to the scala tympani—the inferior lamella of the

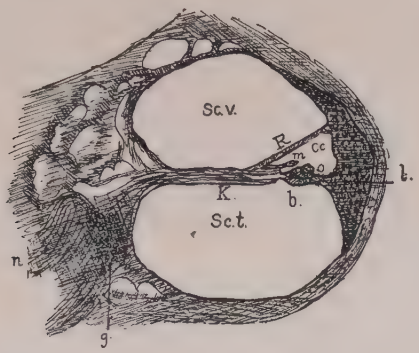



FIG. 111.—Enlarged section of the cochlea of the new-born: *Sc. v*, Scala vestibuli; *Sc. t*, scala tympani; *K*, lamina spiralis ossea; *b*, lamina basilaris; *l*, triangular ligament; *R*, Reissner's membrane; *Cc*, cochlear canal; *o*, organ of Corti; *m*, Corti's membrane; *n*, fasciculus of cochlear nerve-fibers; *g*, spiral ganglion (Politzer).

lamina spiralis—is known as the basilar membrane. This increases in width from the cochlear end to the cupola.

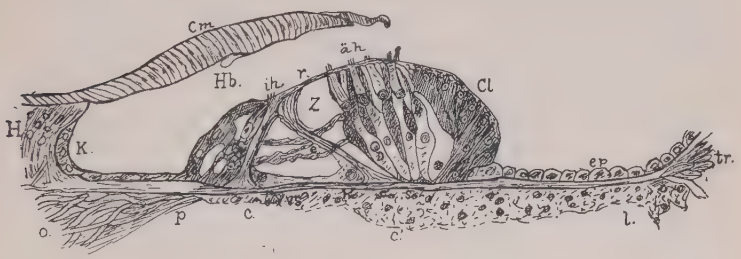



FIG. 112.—Terminal apparatus of the cochlear nerves in the organ of Corti of man (enlarged): *o*, Lamina spiralis ossea with cochlear nerve-fibers; *p–l*, lamina spiralis membranacea; *H*, Huschke's cog, or crista spiralis; *c*, inner column of Corti; *c'*, outer column of Corti; *r*, lamina reticularis; *Z*, cells of Corti; *D*, Deiters' cells; *ih*, inner ciliated cell; *äh*, four outer ciliated cells; *e*, radiating cochlear nerve-fibers passing to Corti's cells; *K*, cells of the sulcus spiralis internus; *Cl*, Hensen's supporting cells; *Cm*, Corti's membrane; *Vs*, vas spirale (Retzius).

It is made up of transverse fibers capable of vibrating individually. The superior plate of the lamina spiralis

separating the cochlear duct from the vestibular scala is known as Reissner's membrane. The external wall next to the bony capsule is highly vascular and is termed the stria vascularis. The flat epithelium which lines the cochlear duct changes into cylindric cells with long cilia on the surface of the basilar membrane next to the osseous lamina. These constitute the **organ of Corti,** the presumptive sensory termination of the auditory nerve (compare Fig. 112). Near the center of this epithelial prominence is a longitudinal tunnel lined on both sides by a row of lengthened (non-ciliated) epithelial cells, the columns of Corti, which, by inclining, meet at the top and inclose this tunnel. The nerve fibrils coming through the osseous lamina spiralis terminate in the ciliated cells. The cilia are covered by a cuticular plate, the **membrana tectoria,** which arises from the apex of the triangular cochlear duct.

## PHYSIOLOGY OF THE EAR.

**290.** Sound is perceived when the ear is reached by aërial vibrations ranging in frequency from about 16 to 50,000 a second. But it is only between the range of 40 and 4000 vibrations a second that sounds can be employed for pleasurable musical purposes. The theoretically simplest form of vibration is that described by a swinging pendulum, and is termed mathematically a sinus wave. Such sinus waves produce simple tones. They can be obtained by means of some forms of open organ-pipes or from tuning-forks mounted on resounding boxes. Almost all tones produced by other means are complicated, consisting of a fundamental note with a variable number of overtones. Their graphic representation is hence entirely different from that of a sinus wave. The number and height of overtones, combined with the fundamental note, give each sound the characteristic termed musically the timber, or quality. The trained ear can detect these overtones within certain limits. By means of so-called resonators their existence can be demonstrated physically

(Fig. 113). Noises differ from tones, first, by having a large number of discordant overtones, and, secondly, by the irregularity of their duration.

The funnel-shaped and movable auricle of animals aids in locating sounds, as the sound is loudest when the auricle points in its direction. In man this function is lost, and the auricle is of but little use in intensifying sound-waves by reflection.

The membrane of the drum is remarkably sensitive to sound-waves, both on account of its thinness and especially by reason of its curvature. It is set into vibration by any sound-waves entering the meatus. By reason of the curvature of its radial fibers the low energy of sound-

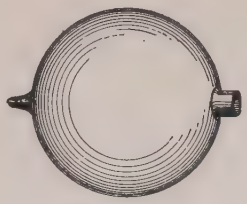


FIG. 113.—Helmholtz's resonator.

waves suffices to produce a sufficient mechanical effect upon the handle of the hammer to cause it to vibrate. The hammer is thus made to swing around an axis formed by the ligaments attached to its neck. This vibration is transmitted through the articulation to the head of the anvil, and through the long process of the latter to the stapes. With sufficiently intense tones visible vibrations of the drum membrane and ossicles may be obtained. Under ordinary circumstances, however, their extent of movement is of microscopic dimension. When the membrana tympani is pressed inward, the pressure is transmitted through the stapes to the perilymph of the labyrinth, and the membrane of the round window can be made to bulge visibly. Sound-waves thus travel through the perilymphatic space of the vestibule and the vestibular scala of the cochlea, returning from the end of the latter

by way of the scala tympani to the round window. Through the thin membranous walls of the cochlear duct the vibrations are communicated to the endolymph. According to the theory of Helmholtz, there are in the cochlear duct structures tuned to resound with all notes, and these are presumably the fibers of the basilar membrane. How these sympathetic vibrations are transformed into activity of the individual nerve-fibers is as yet beyond our comprehension.

The inward movement of the hammer is accurately followed by the corresponding motion of the anvil by reason of minute cogs on both ossicles underneath the articulation, which interlock during inward movement. But when any traction pulls the manubrium outward, the anvil does not follow beyond the slight limit set by the elasticity of its ligaments.

There is not much known about the functions of the muscles of the ossicles. It has been shown in animals that the tensor tympani pulls the hammer inward at the beginning of every loud sound. This is a momentary, not a continuous, muscle-jerk of reflex nature. Some persons can contract the tensor tympani voluntarily in connection with yawning movements, and during this period they hear a low humming sound and are less sensitive to external sounds. The tensor tympani muscle is under the control of motor fibers of the fifth nerve, while the stapedius muscle is innervated by the facial nerve.

**291.** The sensitiveness of the membrana tympani to sound-waves is greatest when the air-pressure is equal on its two sides. This equilibrium is maintained by periodic ventilation of the drum cavity through the Eustachian tube. The walls of the cartilaginous part of the tube are in actual contact, but this contact is overcome easily by any increased air-pressure in the pharynx. Hence on closing the nostrils and mouth and raising the pharyngeal air-pressure by an expiratory effort air can be forced through the tube into the middle ear (Valsalva's experiment). The diminution of the pharyngeal air-pressure

during an inspiration with closed nostrils and mouth is not sufficient to open the tubal walls. But if a swallowing movement be performed while the nostrils are held closed, the air is sucked out of the tube and middle ear (Valsalva's negative experiment). The Eustachian tube gapes normally during the act of swallowing, by reason of the combined action of the tensor and levator palati muscles. During this momentary dilatation of the tubal caliber the normal ventilation of the middle ear takes place. In some persons the tube also opens during yawning. The gaping of the Eustachian tube during swallowing can be shown by holding a sounding tuning-fork in front of the nostrils. The sound, ordinarily inaudible, is heard during the act of swallowing. When the tube is obstructed morbidly, the air in the middle ear is gradually absorbed by the blood in the capillaries, and its tension is lowered below that of the external atmosphere. The external air then presses the membrana tympani inward, thereby producing a feeling of fulness and a diminished sensitiveness to sounds.

**292.** The admission of sound-waves to the drumhead is interfered with by any occlusion of the meatus. But when there is still a narrow path left, sounds are only moderately enfeebled. Small holes in the membrana tympani do not interfere much with its normal function. Larger defects reduce its action upon the hammer in proportion to their extent. Even in total absence of the membrana tympani and ossicles the hearing power may be still practically useful, though much enfeebled. Any morbid process, however, which interferes with the mobility of the ossicles, such as contact with the swollen mucous membrane or rigidity of the articulations, reduces the transmission of sound to the oval window to a large extent. Of all obstacles to sound-conduction none are more damaging than ankylosis of the foot-plate of the stirrup in the oval window. But even in this condition sound-waves reaching the drumhead are still faintly perceived.

**293.** Sound-waves can reach the labyrinth through another route besides the conduction from the drumhead through the ossicles to the oval window. When waves are made to pass through the bones of the skull, they reach the labyrinth and cause the sensation of sound. This is termed bone-conduction. Sound-waves in the air, however, do not cause perceptible vibration of the skull bones, except in the case of very high notes. Such high tones, produced, for instance, by the Galton whistle or by the chirping of insects, are perceived nearly as well when the meatus is occluded. All sound-waves, however, can be passed through the cranial bones by placing the latter in contact with the vibrating solid—for instance, the stem of a tuning-fork. Aërial waves can be conducted into the skull by a thin elastic plate of rubber (the audiphone) held between the teeth. But their intensity is far below that obtained by conduction through the normal drumhead and ossicles.

When sound-waves reach the two healthy labyrinths by bone-conduction, the sensation is not referred to either ear, but simply to the head. But if an obstacle exists to sound-conduction either in the meatus or in the chain of ossicles, the sound perceived through bone-conduction is heard loudest in the ear thus impaired. If, for instance, a tuning-fork be placed against the teeth or the forehead, it is heard loudest in the ear the meatus of which is occluded. This is known as Weber's test.

The binaural perception of aërial sound-waves enables us to detect the direction from which the sound comes. When both ears are normal and alike, the observer recognizes the greater loudness in the ear turned toward the source of sound, and by gradual movements of the head is able to locate it.

**294.** The internal ear serves as the organ of another sense besides that of hearing. For want of a better term this has been called the *static* sense, or, less appropriately, the sense of equilibrium. The semicircular canals enable vertebrate animals to estimate the motion of their

bodies relative to the surrounding space as well as their position with reference to the action of gravity. As these sensations do not ordinarily enter the domain of consciousness with the vividness characteristic of the activity of the other senses, the static sense is not recognizable by self-observation, except under selected experimental conditions. The static sense can be demonstrated subjectively by rotating the observer while seated on a whirling platform. With closed eyes one perceives unmistakably the direction and the rapidity of the rotation, until this becomes uniform in speed. For it is only the acceleration, or negatively the retardation, which is perceived, not the uniform motion. The arrest of motion is again felt and is followed by a transient subjective feeling of rotation in the opposite direction, a negative static after-image, so to speak, of fictitious nature. If the head is maintained in any inclined position, the direction of the rotation is referred subjectively to the axes of the head, irrespective of the motion of the body, and the reversed after-sensation is likewise referred to the axes of the head and moves with the latter when the position of the head is voluntarily changed. An objective evidence of these static sensations are certain reflex movements of the eyes. When the eyes are not intentionally controlled by the subject, they are rotated in a direction opposed to that of the whirling table with a speed equal to that of the mechanical rotation. After extreme version they return with a sudden jerk to nearly their initial position, from which the contrary rotation is again assumed. These movements can also be felt by the finger placed on the closed lids. These ocular movements enable us to estimate the relation of the body to external space and to conform the visual sensations with those furnished by the static sense. If for any reason the eyes do not move at the same speed as the whirling table, the images of external objects wander over the retina and the sensation resulting therefrom is incorrectly interpreted as indicating motion of external objects. The eye movements may hence be

called compensatory. The static sensations as well as the compensatory movements of the eyes are absent in a large proportion of deaf-mutes when tested by whirling (James). This fact supports the view that both the sensations and the ocular movements are started from the semicircular canals, as this part of the external ear is found destroyed in many, though not in all, deaf-mutes.

In birds passive rotation results in a swinging motion of the mobile neck and head comparable to the compensatory eye movements of mammals. This reflex movement is prevented by extirpation of both entire labyrinths, provided the eyes are kept covered, as otherwise the movements are started in a reflex manner by visual sensations.

In birds, especially pigeons, the large semicircular canals are freely accessible and have hence been experimented upon extensively. The most decisive observation made in this manner refers to the occurrence of swinging motions of the mobile neck in the plane of the one canal, which has been either divided or plugged. When the entire labyrinth is destroyed, the animal suffers from extreme incoordination of movements, from which it recovers largely in the course of time. From a most painstaking and varied series of experiments Ewald has come to the conclusion that the labyrinth exerts a reflex tonus upon the entire muscular system, and that any movements of the body in any one plane become incoordinate if not controlled by the intact semicircular canal of that plane. After destruction of the labyrinth the animal gradually learns to regulate the extent of its movements by the sensations furnished by the other senses.

A physical explanation of the functions of the semicircular canals has been suggested by Mach, Breuer, and by Crum Brown, which seems to harmonize with all the facts. Each semicircular canal, with its ampulla and the utricle, forms a complete hollow ring with fluid contents —the endolymph. The three semicircular canals are strictly at right angles to each other and hence correspond to the three planes of space. The semicircular canals of

one ear are so mated to those of the other side that rotation of the head in any possible plane involves rotation of at least one pair of semicircular canals around its axis. On account of the bilateral symmetry of the two labyrinths the direction from ampulla to semicircular canal is the opposite in one ear from what it is in the other. On account of the inertia and the mobility of the endolymph this fluid lags behind in any rotation of a semicircular canal until wall and fluid contents have acquired a uniform velocity. If, hence, a semicircular canal is rotated, for instance, with its ampulla in advance,—there results either a motion of the fluid in the center of the caliber in the opposite direction, or at least an increase of pressure in the ampulla on account of the hindrance of the flow in the extremely narrow semicircular canal. These movements or changes in the pressure of the endolymph excite the nerves terminating in the cilia of the maculæ. Within a short time after rotation has begun the endolymph moves with the same velocity as its wall, and now the rotation is no longer perceived if the eyes are closed. When, on the other hand, the rotation of the head is stopped, the inertia of the endolymph starts again a current in the opposite direction, and the nerves of the opposite ear are thrown into activity—hence the after-sensation of (fictitious) negative motion.

It is not merely the acceleration or retardation of a rotary movement which we can perceive, but also any change of speed in horizontal or vertical translation. Of this we can assure ourselves by observations, with closed eyes, in elevators and smooth-running railroad cars. It is not quite so clear how the semicircular canals are influenced by movements not rotary in character, but in all probability similar changes of intra-ampullary pressure are thus created, due to the fact that each ampulla is continuous on the one side with the very much narrower canal, and in the other direction with the much wider utriculus.

**295.** The movements of the labyrinthine endolymph

started by rotations produce the feeling of dizziness, but the vehemence necessary for this sensation varies enormously in different persons, so that some are easily made dizzy, others only by extreme rotations. Morbid irritation of the semicircular canals—for instance, when due to caries—is hence accompanied by characteristic vertigo. The connection with the semicircular canals explains the frequent occurrence of dizziness in the course of various forms of ear disease. Lesions of the labyrinth are especially characterized by vertigo and unsteadiness, which persist until the patient has learned to depend entirely on the evidence of his other senses. In deaf-mutes with destroyed semicircular canals dizziness can no longer be produced by rotation. These patients have, on the other hand, the disadvantage that they cannot learn to perform bodily movements requiring an accurate sense of equilibrium, especially while closing their eyes.

**296.** The ordinary sensibility of the ear is very acute. Even the most delicate touch of the skin of the meatus, the drumhead, or the exposed tympanic walls with a blunt probe is painful. Mechanical irritation of the lining of the meatus is apt to cause a characteristic reflex—viz., fits of coughing.

The gross anatomy of the ear was mainly developed by the great anatomists of the sixteenth century, Vesalius, Eustachius, and Fallopia. At the end of the seventeenth century Valsalva added many details. Since that time the anatomy of the ear has been completed gradually by numerous contributors. Good detailed accounts can be found in all larger treatises on systematic anatomy. In otologic literature the fullest descriptions are in Schwartze's *Handbuch der Ohrenheilkunde*, 1892, and in Politzer's *Ohrenheilkunde*, fourth edition, 1901 (English translation by Dodd, 1892).

Politzer has also written an indispensable guide for the dissection of the ear, *Zergliederung des menschlichen Gehörorgans*, 1889. The physiology of hearing was almost wholly the work of Helmholtz, and is detailed in his *Lehre von den Tonempfindungen*, 1870 (English translation by Ellis, *Sensation of Tone*, etc., second edition, 1885).

The semicircular canals have been extensively experimented

upon since the days of Flourens. Goltz was the first to characterize them as the organ of a special sense of equilibrium. The most extensive researches on the subject are those by Ewald in his *Phys. Untersuchungen über d. Endorgan des Nervus Octavus*, 1892. The observations on man made on the whirling table by Mach, Breuer, and by Crum Brown are excellently described by the latter in a lecture in *Nature*, June 20, 1895.

## CHAPTER XXXI.

### GENERAL ETIOLOGY OF EAR DISEASE.

**297.** Notwithstanding the deep protected location of the organ of hearing, it is very frequently affected by disease. According to various statistics, the external ear is involved in 25 per cent., the middle ear in 70 per cent., and the internal ear and nerve in about 5 per cent. of all ear patients. Traumatism plays but a small rôle in the production of ear disease. Blows may lead to bloody effusions in the auricle with subsequent deformity or to rupture of the drum-head. Foreign bodies in the meatus, a frequent accident in childhood, cause serious mischief only if violence—for instance, during attempts at extraction—wounds the meatus or drumhead and opens the gate to infection. Slight traumatism combined with subsequent infection is a common result of scratching the meatus with pins, hair-pins, and other articles. The thin skin is very easily abraded, and, being covered with dust containing living germs, furuncles, diffuse inflammation of the meatus, and even extension to the middle ear are not an uncommon penalty for this habit. Diving under water accounts for some ear disease, especially when certain unfavorable conditions preexist. Wax present in excess will swell when wetted and may now occlude the meatus. A former cured suppuration may be rekindled if a perforation of the drumhead permits the water to reach the middle ear. Cold water pressing against the intact membrana tympani sometimes, though rarely, starts the extension of a catarrhal process from the pharynx to the ear. All this can be guarded against by a plug of ordinary non-absorbing cotton in the ear while bathing.

Less common, but more serious, is acute otitis media due to the entrance of water through the Eustachian tubes as the result of swallowing under water.

**298.** The majority of affections of the middle ear, excepting tubercular otitis media and sclerosis, originate from extension of disease in the nose or pharynx. In a broad way it may be stated that all cases of catarrhal or purulent middle-ear disease are preceded by nasopharyngeal lesions, except that some of the eruptive fevers (measles and scarlatina) may involve the mucous membrane of the middle ear and of the nasopharynx at the same time. In all the various forms of inflammation of the middle ear nasopharyngeal lesions are either present or were present at the start. In some instances of proliferative and of serous catarrh of the middle ear the dependence on the lesions in the air-passages can be shown by the successful results of nasopharyngeal treatment. This success is, however, not always obtained. Suppuration of the middle ear, on the other hand, after it is once started, continues independently of the condition in the nasopharynx, and is hence not cured by their successful removal. But when the history shows frequent recurrences of otitic suppuration after natural or surgical cure, the benefit of proper nasopharyngeal treatment is easily demonstrable. The nasopharyngeal origin of ear disease is often plainly suggested in one-sided affections by the limitation of the ear disease to the side of the nasal stenosis.

The etiologic relation of the different forms of nasal and pharyngeal disease to aural affections can be summarized as follows: Ordinary acute coryza and pharyngitis or tonsillitis do not often cause ear trouble if the respiratory passages had hitherto been structurally normal. The liability to involvement of the ear increases, however, with the degree of previous structural anomaly, especially if of an obstructive character. In children the most important predisposing lesion is enlargement of the pharyngeal tonsil and, to a much less extent, hyper-

trophy of the faucial tonsils. In adults the adenoid overgrowth plays a minor rôle in frequency and importance, while any form of nasal stenosis is an important pathogenic factor. As long as the obstructive lesions are not accompanied by acute or subacute inflammation they do not lead to any acute ear disease. But it is their presence which renders any complicating acute nasal or pharyngeal inflammation a menace to the ear. The form of ear disease resulting from these conditions are retention of wax in the meatus, purulent otitis, or serous catarrh of the middle ear. In children the acute ear involvement is usually the purulent form. After the age of puberty serous catarrh is more likely to occur than purulent otitis. In cases of one-sided nasal stenosis the ear of the same side is much more likely to suffer than its mate. The danger of nasopharyngeal inflammation as regards the ear is much greater when the respiratory lesions are part of some general disease, as measles, scarlet fever, and especially influenza, than in affections purely localized in the nose and throat. The danger from diphtheria is about the same as from ordinary pharyngitis, at least numerically, although the ear disease when it does follow diphtheria is likely to be more severe.

Subacute inflammatory processes in the nasopharynx of children with enlarged pharyngeal tonsil result in catarrh of the Eustachian tube, an affection which may be said to have a subacute course.

Purely chronic inflammatory conditions in the nose and throat lead to the adhesive form of middle-ear catarrh, especially when the nasopharyngeal condition tends toward hypertrophy. A material determining factor in the extension of the hyperplastic process to the ear is the narrowing of the nasal passage by septum irregularities. The influence of nasal stenosis is generally upon the ear of the same side, but in the chronic and insidious form of disease there are occasional exceptions to the rule. Acute or subacute catarrhal exacerbations

in the course of hypertrophic rhinitis usually intensify the middle-ear affection by corresponding exacerbations of the ear disease.

Diseases of the middle ear are thus not only an extension of nasopharyngeal processes, but, on the whole, also a copy of the type of the disease in the air-passages. The ear disease may, however, persist after the original disturbance in the nose or pharynx has ceased. Moreover, the course of the ear disease may become complicated by secondary changes, such as adhesions in catarrhal otitis and bone affections in the purulent form.

**299.** The microbes causing purulent inflammation of the middle ear have been identified as the pneumococcus, streptococcus, staphylococcus, bacillus pneumoniæ (Friedländer), bacillus pyocyaneus, and exceptionally a few others, sometimes in combination. In serous catarrh of the ear the same bacteria have been found in a small number of observations. Whether the etiologic difference between purulent and serous otitis depends on a difference in the number of microbes or on a different mode of reaction of the tissues in different subjects is unknown. Clinically the two diseases are separate and distinct, and the occurrence of one renders the future appearance of the other very unlikely, even in the ear of the other side.

Pathogenic microbes can reach the middle ear through the Eustachian tube—for instance, during violent efforts of coughing or blowing the nose. The most striking demonstration of this mode of pyogenic infection is the otitis following within eight to twenty-four hours after the entrance of water from a nasal douche into the tube. In most cases, however, it is probably less a transport of infectious material through the Eustachian passage than a growth of the parasite in the mucous membrane or the lymph-channels of the tube which leads to otitic infection. Yet the pharyngeal end of the tube is not rarely normal during life or at the autopsy in acute suppurative otitis.

Whether the plastic or hypertrophic form of disease depends on the presence of parasites is not known, either in the case of the ear or of the respiratory lining. The process in these cases is a continuous one from the pharynx through the tube to the tympanic cavity.

**300.** "Taking cold" is an important factor in the causation and perpetuation of middle-ear disease, especially in serous catarrh and exacerbations in the course of hypertrophic otitis media. The mechanism of "taking cold" and the known facts concerning it have been discussed in the chapter on Etiology of Nasal Diseases (¶ 13). The doubt whether chilling of the body can start an inflammatory process in a hitherto normal structure does not apply in the case of the ear, since its involvement under such circumstances means only the extension of preexisting nasopharyngeal disease. A clear history of "cold" as an etiologic factor can be obtained only in a small number of instances, but in some of them its influence seems well supported by the evidence. There certainly can be no doubt that careless exposure and insufficient protection exert an unfavorable effect upon the course of any inflammatory affection of the middle ear. Habitually cold feet should receive attention in connection with any ear disease (compare ¶ 13).

**301.** The eruptive fevers are responsible for a large proportion of ear diseases. In measles an inflammatory lesion with exudation has been found in every fatal case examined, while in scarlet fever we know at least clinically that involvement of the ear is very common. The first lesion in eruptive fevers is probably the specific exanthema in the mucous membrane of the Eustachian tube and middle ear, coincident with the eruption in the pharynx and perhaps prior to the cutaneous manifestation. But this specific lesion follows a benign course and is not revealed clinically at all, unless complicated by secondary infection with pyogenic microbes. The probability of this complication increases with the degree of previous structural anomaly in the nose and pharynx

and the intensity of their involvement by the eruptive fever. Diphtheria does not extend to the ear often, but when it does, the disease is of a severe type, though rarely due to the bacillus of diphtheria itself. Influenza may cause a primary otitis media, of a hemorrhagic, but generally not purulent, character. Within the past few years this form of influenza otitis has become less common, while the ordinary purulent otitis secondary to a purulent influenza rhinitis is seen oftener. A large number of children with purulent otitis are scrofulous. Whether this disease itself—viz., the poisoning of the system from some minute tubercular focus in lymph-glands—reduces the resisting power to pyogenic infection is not definitely proven, though probable. The direct cause, however, of the purulent otitis is the enlargement of the pharyngeal tonsil, together with the frequent spells of acute and subacute nasal inflammation common in scrofulous children. Eczema of the face or scalp is likewise a frequent manifestation in scrofula, and its extension to the auricle is, therefore, not uncommon.

Extension of pyogenic infection from the middle ear into the mastoid process or into the bone in general is favored by any impoverished state of nutrition—for instance, diabetes.

Non-suppurative ear disease, especially the proliferative form, is not a rare sequel to typhoid fever. Relatively often I have seen post-typhoid trouble in the form of plastic middle-ear disease, often one-sided, of rapid progress for a number of months, but afterward permanently stationary. Diseases of the middle ear, while not directly caused, are usually unfavorably influenced by any malnutrition, as anemia and digestive disturbances, exactly like the nasal and pharyngeal affections starting them (compare ¶ 16 and ¶ 17).

**302.** Morbid change in the internal ear and nerve-ends may result from various intracranial diseases, first among which ranks cerebrospinal meningitis. Atrophic processes in the auditory nerve occur in the course of tabes.

Severe affections of the internal ear are also due in limited number to scarlet fever, mumps, typhoid fever, syphilis, especially the inherited form. Sometimes they coincide with severe forms of digestive disturbances. Nerve-deafness occurs in a small but noticeable proportion of patients with pigment degeneration of the retina. A curious observation, repeatedly noted, is that among albinotic (white) cats there are very many deaf-mutes.

Direct injury to the labyrinth has been observed after large doses of quinin and in few very rare instances from salicylate of sodium. Affections of the teeth may influence the ear. A mild purulent otitis apparently traceable to a coryza coincides quite often with teething in children. Caries of any of the rear teeth or even the normal eruption of wisdom-teeth is sometimes attended by neuralgic pains referred to the ear, the origin of which is found only after a definite search.

**303.** The surroundings and occupation may have an influence upon the ears. Continuous loud noises, like heavy hammering, impair the hearing gradually by setting up a sclerotic process in the internal ear. Boilermakers, workmen in machine shops, and, to a less extent, railroad engineers and firemen, show a large percentage of cases of progressive nervous deafness. The danger is greater to those who enter such employment with some previous anomaly in the middle ear. Artillery men are somewhat subject to the same danger, besides suffering at times from rupture of the drumhead in consequence of detonations. Opening the mouth to facilitate equalization of air-pressure through the Eustachian tubes and wearing cotton plugs in the ear are well-known protective measures among the artillery. Whether the cotton plug would also protect boilermakers and others exposed to loud din is probable, but has not been tested sufficiently. Mechanical accidents to the drumhead may occur too in workmen working in pneumatic caissons in compressed air under water, as in bridge-building. It is not the abnormal air-pressure by itself, but rather a too sudden

change in the pressure, which, when not quickly compensated through Eustachian ventilation, may cause rupture. Too sudden a diminution of such extreme air-pressure leads to liberation of air-bubbles in the capillaries, often with minute hemorrhages, and this accident has occurred as well as in the labyrinth of the ear as in the central nervous system.

**304.** Heredity is an important factor in the predisposition to ear disease. The liability to aural affections is decidedly increased by the history of disease in the parents or near relatives. While plastic and sclerotic middle-ear processes are the commonest forms observed in predisposed families, still the individual under the influence of a bad heredity may acquire any type of ear disease. The intermarriage of deaf-mutes leads to a large proportion of deaf-mutes in the offspring, but still with a preponderance of normal children.

## CHAPTER XXXII.

### SUBJECTIVE SYMPTOMS AND METHODS OF EXAMINATION AND TREATMENT IN EAR DISEASES.

**305.** *Pain* in the form of more or less severe earache is produced by acute inflammation in either the meatus or the middle ear, and especially in the mastoid bone. Its severity and duration are proportionate to the intensity of the inflammatory processes. Chronic disease does not cause pain. Subacute catarrh of the Eustachian tube is sometimes productive of earache in children. Acute pharyngeal lesions near the Eustachian orifice, such as ulcers near the lateral recesses of the pharynx and wounds of the upper part of the tonsil, give rise to sharp pain referred to the ear. Erupting wisdom-teeth and disease of any tooth back of the bicuspids can induce otalgia—neuralgic pains in the ear.

*Itching* in the ears is at times a source of great distress to nervous people. It may be due to an easily overlooked area of slight eczema in the meatus, or, on the other hand, to venous congestion around the Eustachian orifice in neurasthenics with irritable nose. It is often very annoying in hay fever.

A *full* or "*stopped-up*" feeling in the ears results from occlusion of the meatus by wax, especially if the latter presses on the drumhead. Furuncles and diffuse inflammation of the meatus cause stuffiness in proportion to the swelling present. Stuffiness is characteristic, too, of serous catarrh, while in the plastic form of middle-ear disease it is a less constant or prominent symptom. It is, of course, present during the acute stage of purulent otitis.

In connection with the "stuffy" feeling patients mention the subjective want of resonance of their own

voice. It sounds muffled to the patient, even though his hearing for external sounds may not have suffered appreciably. A similar muffling of the sound is often noticed, especially in one-sided disease, when a noise is produced by scratching the region around the ear. Quite different from this subjective muffling of the voice is the excessive resonance, which has been termed "autophony." It is complained of by patients without ear disease, but whose Eustachian tubes presumably gape to an abnormal extent on account of inflammatory rigidity of their walls or perhaps from wasting of the cushion of fat in the external wall of the tube.

*Vertigo* varying from momentary slight dizziness to a more or less continuous feeling of insecurity may result from various ear affections. Pressure of wax against the drumhead, syringing with cold water or with too much force, especially when there is disease of the attic, can cause it. Persistent dizziness is a grave symptom in suppuration of the middle ear. Disease limited to the tympanic cavity without retention of pus in the attic does not provoke vertigo unless there is caries of the labyrinth. This symptom, however, is characteristic of any involvement of the semicircular canals, whether the disease be primarily labyrinthine or due to extension to the internal ear. Severe ear vertigo leads to nausea and vomiting, staggering, or even the inability to rise from the recumbent position.

**306.** Noises and ringing in the ear, technically termed *tinnitus*, are a serious annoyance to many ear patients. Some neurasthenics have been driven by it to suicide. Wax in the meatus may cause a roaring sound. In suppurative otitis tinnitus is usually absent, sometimes, however, following later by reason of intratympanic adhesions. In serous catarrh it is a minor symptom. But the hypertrophic form of middle-ear disease—and to a much less frequent extent sclerosis—is characterized by subjective noises, sometimes as the earliest symptom. Disease of the internal ear is not always accompanied by subjective

sounds, though mostly so. The aura of epilepsy is sometimes an auditory illusion. Tinnitus may sound like roaring, singing of birds, ringing of bells, whistling, or hissing of escaping steam. Quite often it is a pulsating noise, sometimes a musical sound or a changing din. It may be heard only in the stillness of the night, or it may be so loud as to drown continuously all external sounds. Neither the anatomic lesions causing tinnitus nor its physiologic mechanism are fully understood. It must, of course, be due to irritation of the intralabyrinthine nerve-ends. Pulsating sounds are due to the pulsation of the arterioles somewhere in the ear, and are often controlled by absolute rest, or transiently by compression of the carotid artery, but are aggravated by any exertion or excitement. In very rare instances pulsating noises have been caused by an aneurysm of smaller intracranial or other adjoining blood-vessels. Snapping sounds which are really objective and can be heard by auscultation through a tube from the meatus to the listener's ear are occasionally due to spasms of the tensor tympani muscle; oftener, however, to contraction of the tensor palati muscle, which some people can control voluntarily. Instances have been known in which a nocturnal ticking was complained of, due to the watch under the pillow. *Diplacusis* is the term applied to the wrong "tuning" of one ear, occasionally observed by musical patients in the course of a mild middle-ear catarrh with secretion. All notes sound a trifle, perhaps half a tone, too high or too low as compared with the normal ear. It depends probably on some circulatory disturbance or slight effusion in the cochlea.

**307.** The *hearing acuity* is reduced more or less by all diseases of the ear except minor affections of the meatus, like small furuncles or slight eczema. Yet this may not be the patient's reason for seeking advice, either because the deafness is scarcely noticeable in the beginning of an affection or because it has been stationary so long that he is accustomed to it, or because it is overshadowed by other symptoms. In most instances of disease of the sound-

conducting parts the hearing is noticeably improved by external noises, like the rattling of railroad cars, which deafen normal persons. In disease of the labyrinth, on the other hand, noisy surroundings reduce the patient's hearing power.

The hearing acuity cannot be measured at present with any scientific accuracy. We would require for this purpose a device furnishing pure tones—without overtones—throughout the entire auditory range, the intensity of which could be measured and regulated with mechanical precision. Despite numerous efforts to utilize tuning-forks, electric mechanisms, telephone, or phonograph for this purpose, no measuring contrivance has been devised, the utility of which is at all proportionate to its complicated mechanism or cost. It is very easy to obtain a single tone of fairly constant or measurable intensity, but the requisite multiplication of notes, especially of pure tones without overtones, makes any such device impracticable. Tuning-forks or steel rods struck by a spring hammer of constant force (Politzer's acumeter) serve very well as a source of a single tone of constant pitch and intensity, the audibility of which depends on the distance from the ear. But they have no advantage over the ticking of a watch. If the distance at which the individual watch is heard by the normal ear is stated as the denominator (d), and the distance at which the patient's ear hears it as the numerator (n), the resulting fraction $\frac{n}{d}$ is a convenient though not physically accurate expression of the patient's hearing ability. But this measurement refers only to the high tones of the watch and is not indicative of the hearing ability for other tones. Since the hearing power may suffer unequally for different parts of the scale, it would be desirable to have some instrument which could supply tones throughout the entire range of audition. Still the watch gives a serviceable method of measuring the effect of treatment upon the hearing power. The hearing distance should be noted while approaching,

rather than while receding from the watch, since in the latter case it is more difficult to state when the audible tick ceases. Young children do not, as a rule, give trustworthy answers when tested with the watch.

The most serviceable method of measuring the hearing acuity for practical purposes is the voice. Monosyllables are repeated louder or nearer until the patient repeats the word correctly. In order to avoid guess-work, the patient must not watch the lips, and single syllables should be pronounced without prearranged order. Different consonants offer variable difficulty of perception, especially in ankylosis of the foot-plate of the stirrup and in affections of the internal ear. Striking confusion in the repeated words raises hence the suspicion of such lesions. The examiner must learn to speak with approximately constant loudness of voice (either whisper or ordinary tone), and test the hearing power by changing his distance from the ear. The range of the voice-test can be increased—for instance, in small rooms—by learning to modulate the voice with constancy, thus speaking first in a faint whisper, then in a medium loud whisper, and finally a loud whisper, and if this does not suffice, repeating in ordinary voice faintly, in average tone, or loudly. One should, of course, be familiar with the normal hearing distance in a given room and under given surroundings (street noise). A fairly accurate record of a patient's hearing power can thus be kept and changes noted. But a comparison of the records of different examiners in regard to changes in the hearing acuity is scarcely as accurate as an intelligent patient's personal opinion, on account of the difference in voices.

**308.** The range of audition can be tested by means of Bezold's continuous tone-series. It consists of a series of tuning-forks, each of which can change its pitch within the limits of nearly one octave by the shifting of movable clamps. The middle register is tested with two organ-pipes with movable stops, while the upper end of the scale is furnished by the Galton whistle. Researches with

the continuous tone-series have shown that the remnant of hearing power in affections of the internal ear is sometimes represented by a small "island" in the middle of the scale or may comprise a fair part of the lower end of the scale, with gaps for certain tones.

For most clinical purposes it suffices to test the hearing power for the lower tones by means of a heavy tuning-fork and for the upper end of the scale by the Galton whistle. A large tuning-fork with a movable clamp, giving from 64 to 128 vibrations a second (C–c), is commonly used. In affections of the sound-conducting apparatus (membrana tympani and chain of ossicles) this is not so readily heard through the air as higher tones, while its perception by bone-conduction is normal or

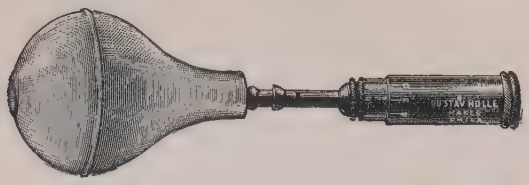



FIG. 114.—Galton's whistle with rubber bulb. The pipe below the opening is filled by a plunger advanced or withdrawn by a screw, each turn being shown by the scale upon the enlarged tube, and its tenths by that on the revolving collar. It gives an audible sound from 0.5 (theoretically, 84,000 v. s.) to 10 or 12 (4200 or 3500).

slightly intensified. The Galton whistle, a miniature stopped organ-pipe, varies its pitch by sliding the stop (Fig. 114). Its range is from 6000 to nearly 50,000 vibrations a second. On some of the more recent patterns the pitch is approximately marked, but this is not absolutely necessary if the whistle is tested by comparison with a normal ear. The perception of the highest notes is not affected by any lesion interfering with sound-conduction, but markedly so by disease of the labyrinth. The shrill tone of the Galton whistle is conducted so much more readily through the cranial bones than through the air that stoppage of the ear by a plug scarcely interferes with its perception. It cannot, hence, detect one-sided disease with certainty.

**309.** The precise site of lesions in the ear is determined by certain differences between the air-conduction (A. C.) and the bone-conduction (B. C.) of sounds in different forms of disease (compare ¶ 293). The tests are made with tuning-forks, mainly the $c^2$, of 512 vibrations a second, and the c of 128 vibrations (Fig. 115). In Rinne's test the fork, while sounding, is held near the meatus, and its loudness is compared with the tone the patient hears on placing the stem firmly upon the mastoid bone. Normally this sound is much louder by air-conduction, and hence heard longer than when conducted through the

FIG. 115.—Tuning-forks.

mastoid bone, and Rinne's test is called positive (Rinne +). All lesions which interfere with the conveyance of sound through the drumhead and ossicles diminish the subjective loudness in the case of A. C., and hence shorten the time during which the tone of the subsiding tuning-fork is heard. Bone-conduction is not thereby diminished, sometimes even moderately intensified. This is especially true of the lower tones. Hence the test with the forks C or c is the most definite. After the time of perception by A. C. and by B. C.—or at least their ratio—has been determined with a watch, it is easy to tell whether the

period of A. C. is shortened in the Rinne test. In extreme cases the result is reversed—the fork is heard longer and louder through the bone than through the air (Rinne negative or −). In the latter case the patient can state readily that he hears the fork louder when placed upon the bone than through the air. When the disease is localized in the sound-perceiving parts without lesion in the middle ear, the normal ratio of Rinne's test is not changed (A. C. > B. C.), but the loudness is diminished both ways. In lesions affecting both the middle and internal ear the test is often indecisive.

In Weber's test a tuning-fork is placed in the median line on the forehead or against the teeth. It is then heard equally loud in both ears if normal or if symmetrically diseased. Any one-sided interference with sound-conduction intensifies the loudness on that side, and in pronounced instances the patient locates the sound entirely in the affected ear. This can be imitated by stopping the healthy ear of one side with a plug. If both drums are diseased, the sound is referred to the ear most affected. On the other hand, any disease in the sound-perceiving apparatus reduces the perception on the affected side. In complicated lesions Weber's test, too, is not conclusive.

Schwabach's test consists in measuring the time of perception in seconds when the fork struck with uniform force is set upon the vertex of the head. Any pronounced shortening of the time the tone is heard by bone-conduction argues in favor of a lesion in the sound-perceiving organ.

Gellé's test is intended to demonstrate fixation of the foot-plate of the stirrup (ankylosis). A rubber tube is put air-tight into the meatus, and the air in it is compressed by means of a bulb. During the time the pressure acts upon the drumhead a sounding tuning-fork set on the tube is heard enfeebled if the stapes is movable (normal), while the intensity of the sound is not altered in case of immobility of this ossicle.

The various tuning-fork tests may all prove more or less inconclusive in doubtful cases. When the results—positive or negative—are well pronounced and the different tests agree, the site of a lesion can be correctly localized on the basis of functional tests. This is true in the majority of clinical cases. There are, however, not rare exceptions in which the different tests do not agree and in which our conclusions drawn from these tests must be guarded.

**310.** *Inspection* of the meatus and drumhead requires the use of a perforated mirror, since otherwise the examiner would cut off his own light. The methods of illumination have been discussed in Chapter III., ¶ 23. The view is hindered by the tortuosity of the meatus and the hairs in it. The meatus is straightened by pulling the auricle upward and backward. The hairs are crowded aside by a speculum. This may be metal or hard rubber. It should be cylindric as far as it enters the meatus, while its outer end flares in order to admit more light. All other shapes are not so advantageous. The diameter varies from 3 to 7 mm., according to the size of the meatus, the larger size permitting the best view (Fig. 116).

If the view is obstructed by the presence of wax, epidermis scales, or pus, the meatus should be cleansed by syringing. The water must be warm, as cold water as well as warm water with undue force causes discomfort and dizziness. While sterility is theoretically desirable, no harm can be traced to ordinary clean water. In acute suppurative inflammation, however, routine syringing should be omitted. A rubber-bulb syringe of ½ to ¾ pint capacity is rather more convenient than a piston syringe. Small syringes are not advantageous. The nozzle should be thin enough to enter the meatus. If necessary to insert the nozzle deeply,—for instance, when thick pus is present,—it is best to protect it by slipping over its tapering end a bit of soft drainage-tubing (about

3 mm. thick). This soft extension of the nozzle saves unnecessary pain on contact.

The normal membrana tympani appears as a grayish, translucent membrane closing the meatus (Fig. 117) (comp. Fig. 1, Plate II.). It is slightly elliptic rather than circular in outline, and its long axis deviates upward and forward about 10 to 15 degrees from the vertical. Through the pellucid membrane the handle of the hammer can be seen attached to it on its internal side in the line of its long axis and reaching from just below its center to nearly its upper periphery. At the upper end of the handle the neck of the hammer is seen as an apparently prominent point. From the point two streaks radiate toward the periphery, the anterior and posterior folds, which separate the membrana tympani proper or tense

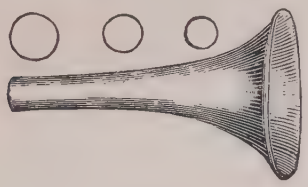


FIG. 116.—Ear speculum: Toynbee's (in metal); Politzer's (in hard rubber).

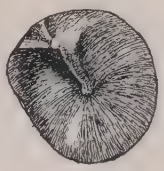


FIG. 117.—Normal membrana tympani (left).

portion of the drumhead from its flaccid upper extension, or Shrapnell's membrane. The latter is not so translucent as the tense portion. It can be seen well only in a roomy meatus. The handle of the hammer slants inward and downward about 35 degrees from the vertical. Hence, on the whole, the drumhead is somewhat funnel-shaped, the sides of the funnel being, moreover, slightly convex toward the examiner. Besides the whole membrane, or, more accurately speaking, a plane laid through its rim, slants downward and inward and forward and inward. The inferior and anterior sides of the meatus are thus longer than the other sides. On account of its shape the drumhead presents to the examiner a bright light reflection next to the lower end of the handle of the hammer, the triangular spot or light-reflex.

**311.** Important changes are noted in the appearance of the drumhead in disease. Serous catarrh, when acute, may give rise to red vascular streaks parallel to the manubrium. In acute otitis media the entire membrane is uniformly red on account of its vascularity. Chronic catarrh changes the pellucid appearance into a dull gray color with cloudiness ultimately effacing the light-reflex. In the course of long-standing catarrh partial calcification of the drumhead may occur in the form of whitish chalky spots.

Whenever obstruction of the Eustachian tube confines the air in the middle ear, it is partially absorbed and its tension sinks below the pressure exerted by the atmosphere upon the external side of the membrana tympani. The latter is hence pressed inward, its funnel-shaped indentation is exaggerated, and the inward slant of the manubrium is increased. On account of being more nearly horizontal than normally, the handle of the hammer is seen foreshortened under the circumstances. Both the bony manubrium, as well as the anterior and posterior folds between the tense and flaccid portion of the drumhead, appear strikingly prominent, while the light-reflex is somewhat enlarged. These appearances indicate Eustachian obstruction and are common to all forms of catarrh of the middle ear.

Morbid effusions of fluid in the middle ear can be seen through the tympanic membrane if the latter is neither thickened and cloudy nor congested to an extent to render it opaque. The lower part of the drumhead appears yellowish or greenish, and a horizontal black line shows the upper level of the fluid. If air be blown in through the Eustachian tube, air-bubbles can sometimes be seen in the fluid present. When there is much effusion, the drumhead bulges and the light-reflex is effaced. More often, however, the membrane is drawn inward by reason of the diminished intratympanic pressure, even when there is moderate effusion.

In acute purulent otitis media a protruding pouch is in rare instances seen in the upper rear part of the

drumhead, formed by a hernia of the mucous layer through the deficient or atrophic middle lamina. Interstitial abscesses have been seen in the membrana tympani. Serous blisters occur on its external surface in myringitis. In this inflammation, localized in the drumhead, but also in influenza otitis, minute hemorrhages are found in its substance. They may also be produced by traumatism. In chronic myringitis the membrane is sometimes studded with small papillary growths.

Traumatic ruptures of the drumhead from foreign bodies or concussions are mostly linear, with edges suffused by blood. The tympanic membrane is normally air-tight, and any perforation in it is indicative of injury or present or former disease.

**312.** Perforations—the result of suppuration of the middle ear—may be of pin-point size in a mild acute case, or may include the entire drumhead in a more destructive type of disease. A very small hole is sometimes difficult to see if covered by loose epidermis scales or dried secretion, or if hidden by the prominence of the wall of the meatus. In shape perforations may be round, oval, or bean-shaped. They may occur in any part of the membrane. It is important to note whether they are in the tense or flaccid portions of the drumhead. Small perforations in Shrapnell's membrane lead into the attic and do not always communicate with the tympanic cavity. Not rarely perforations of Shrapnell's membrane are complicated by defects at the upper periphery of the bony rim, and a fissure may thus be found leading into the attic. Where a large area of the drumhead has been destroyed, a part or even the whole of the hammer and anvil may be also lost.

When a suppurative otitis has passed its acute stage, regenerative changes begin at the edge of the perforation. Provided the defect is not very large, it usually closes as soon as all secretion has ceased. But if the secretion continues after the acute stage,—in other words, in all protracted inflammations,—the edge of the defect becomes

covered with epithelium and the perforation cannot close and remains permanently open. On the other hand, all holes made by the surgeon close with remarkable precision. Even when the entire drumhead has been excised a regeneration usually follows.

Through the hole in the drumhead—if not too small—the mucous membrane of the tympanic cavity is seen, pale when healthy, more or less reddened and thickened when inflamed.

In case of doubt about the existence of a perforation a communication with the drum cavity can be shown in various ways. On inspection through a Siegle speculum (see below) the drumhead will not be seen to move to and fro with changing air-pressure. Auscultation gives a perforation noise when air is forced through the Eustachian tube. If the ear be filled with water, air forced through the tube bubbles out of the meatus. These tests fail if the hole (in Shrapnell's membrane) leads only into the attic and not into the drum cavity proper.

Healed perforations—if larger than a pin-point—are closed by a cicatricial membrane more translucent and more yielding than the membrana tympani on account of the absence of the tense middle layer. Large cicatrices are often flaccid and of abnormal mobility.

**313.** Of limited utility is the examination of the drumhead through the Siegle or pneumatic speculum (Fig. 118). It is a speculum fitting air-tight into the meatus by means of a soft-rubber tube slipped over it with its external end closed by a magnifying lens. Through a lateral tube the air can be exhausted or compressed. The extent of movement of the handle of the hammer under varying air-pressure indicates the mobility, or, vice versâ, the rigidity, of the malleo-incudal articulation. The pneumatic speculum may be used for massage of the drumhead. Alternate rarefaction and compression of air at the rate of two or three times a second can be practised with the mouth or by means of a small rubber bulb (without valve). Elaborate miniature pumps run by

compressed air or electricity have been devised for the same purpose and make an impressive piece of office furniture, but accomplish not much more than simpler apparatus. While vibrating massage of the drumhead is of some slight but unquestionable efficacy in the treatment of chronic middle-ear disease, its utility has been much exaggerated. As it requires a long continuance, it is simplest to teach the patient to do it himself twice daily for one to two minutes, by means of a rubber tube led from his mouth to his ear. Practically the same influence can be obtained by inserting the forefinger into the meatus, grasping the lobule with the thumb, and making rhythmic

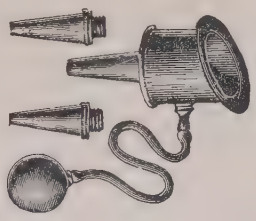


FIG. 118.—Siegle's pneumatic ear speculum.

movements to and fro. The finger acts upon the air in the meatus like the piston of a syringe.

**314.** In all diseases of the middle ear it is important to determine the degree of *patency of the Eustachian tube.* There is no convenient method of ascertaining the degree of patency in absolute measure—for instance, with reference to the air-pressure necessary for inflation. But information sufficiently accurate for clinical purposes can be easily obtained. Normally an expiratory effort made while mouth and nostrils are held closed will at once force open the tubes, and the subject feels the ear filling with air under pressure (Valsalva's experiment). The full feeling is instantly relieved by swallowing, which act, by causing gaping of the Eustachian lips, permits equalization of air-pressure in the drum cavity and the throat. The more obstructed the Eustachian channels by either swelling or sclerosis of the mucous membrane,

the more difficult is Valsalva's experiment. The patient can thus indicate very accurately any difference between the two sides. When the Eustachian obstruction is considerable, inflation by the Valsalva method becomes impossible. Politzer inflates the middle ear by vigorous compression of a large rubber bag while swallowing water held in the mouth. The bag should have at least 300 c.c. (10 oz.) capacity (Fig. 119). Its nozzle should have a wide caliber, and should be connected by means of a short, soft-rubber tube with a large glass ball fitting air-tight into the nostril. During swallowing the palate closes the pharynx, and the air, forced into the nostril and thus confined, forces its way through the Eustachian tube while the latter gapes. The greater the Eustachian obstruction, the more pressure is required to force in the

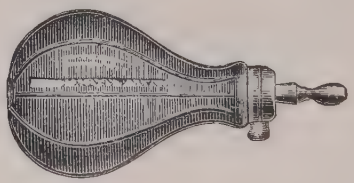


FIG. 119.—Politzer air-bag.

air, until, in extreme instances, the Politzer inflation becomes impossible. By bending the head forcibly toward one shoulder the gaping of the Eustachian orifice is interfered with on the flexed side, and the procedure can thus be partially limited to one ear. If the compression of the bag does not coincide with swallowing, the air gets into the esophagus and produces discomfort. In very rare instances the Politzer inflation has caused the rupture of cicatrices (of perforations) in the drum-head, but without doing any permanent harm. Gruber has substituted the forcible intonation of a harsh guttural "k" or the syllable "hock" for the act of swallowing. The palate is closed, but the Eustachian mouth does not gape during the articulation of "hock," and hence Gruber may fail, where Politzer succeeds.

**315.** For most diagnostic and therapeutic purposes inflation by means of the Eustachian catheter is the most satisfactory procedure (Fig. 120). With the catheter well introduced into the Eustachian orifice air can be forced easily through a passage so swollen that inflation by other methods is impossible. Besides, we can gauge its result objectively by listening through a tube connecting the ear of the patient with that of the surgeon (Fig. 121). The introduction of the catheter should not be painful, although always disagreeable. When the nasal passage is inflamed, sensitive, or narrowed, a cocain spray may be used, especially in timid children. Metal catheters are preferable to rubber, as they keep their shape on boiling. Since syphilis has been transmitted through

FIG. 120.—Eustachian catheter.

FIG. 121.—Auscultation tube.

the use of the catheter, thorough cleanliness, if not absolute disinfection by boiling soda solution, is imperative. Flexibility of the instrument is no object, since when it has a proper curve we can very rarely improve the latter by bending it. Its end should be rounded, and the catheter must not be needlessly long—not more than 15 cm. Many in the shops are of improper length. The instrument is introduced by gliding it along the floor of the nose until its tip touches the pharyngeal wall, whereupon it is turned toward the ear so that its curve lies in a plane about horizontal or slightly tilted upward and outward. It is then withdrawn 1.5 to 2 cm. (in the adult), and, as a rule, it can now be felt that the tip glides over the prominence of the Eustachian lip into its orifice.

Upon blowing through the tube the air is heard entering the middle ear. If stenosis of the nasal passage prevents the regular mode of seeking the Eustachian mouth, the catheter must be manipulated by gentle rotation in different directions. A very thin, flexible, hard-rubber tube has the advantage over a stiff catheter in this case. If the obstacle in the nose cannot be overcome, the catheter should be inserted through the nostril of the other side and turned toward the desired ear after its beak has passed the nasal septum. By forcing the outer end of the catheter away from the septum it is generally possible to inflate the opposite ear. Inflation is done with a single (not double) rubber hand-bulb (with air-valve), connected by means of soft-rubber tubing with a tip to fit into the end of the catheter. The listener hears a faint, clear, blowing sound when the air enters a normal Eustachian tube. Constriction or swelling of the tube gives the sound a hissing quality. Mucus in the tube or fluid in the middle ear produces a bubbling râle.

Of great prognostic significance is the degree of subjective improvement in hearing or the lessening of tinnitus and fulness obtained by inflation with any method.

The only possible accident from the use of the catheter is emphysema of the pharynx and side of the neck. If the tip, especially if rough, happens to scratch the mucous membrane, the air may enter the wound and distend the interstitial lymph-spaces. An immediate tumefaction occurs, with feeling of oppression. The swelling is soft, elastic, and can be deeply indented by the finger. It disappears in a few hours without harm.

In order to blow the vapor of chloroform into the middle ear, the rubber tip of the air-bag fitting into the catheter can be dipped into this fluid, or a drop of it may be dropped into a Politzer bag. The vapor of iodin or of turpentine can be used for Eustachian inflation by placing the material (tincture of iodin or turpentine) on cotton in a capsule between the rubber bag and the nozzle. A similar metallic capsule can be used to heat the

air by holding it over a flame. Finely divided chlorid of ammonium may be generated for inflation by letting the air pass through a branched tube over $NH_3$ and HCl solution contained in separate bottles. As the separate currents of air laden with the fumes join in a third receptacle, the $NH_4Cl$ is formed as a finely suspended cloud (Fig. 122).

Probing of the Eustachian tube can be practised with a flexible celluloid or rubber probe or a stiff catgut (violin

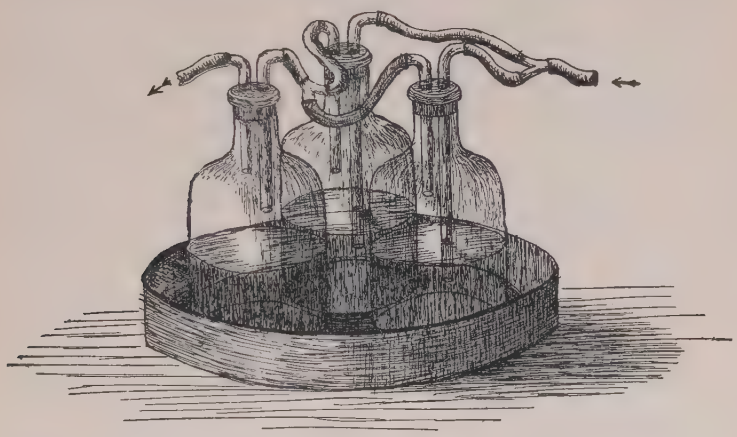


FIG. 122.—Apparatus for developing chlorid of ammonium in a state of fine subdivision. A current of air is blown in the direction of the arrow through the two bottles on the right, one containing hydrochloric acid, the other a solution of ammonia. When the two vapors meet in the bottle on the left, which contains water, chlorid of ammonium is formed, while any excess of either acid or ammonia fumes is absorbed by the water. The tube on the left side connects with the catheter.

D-string) introduced through the catheter. Normally a probe suitably marked to indicate its length within the catheter can be pushed about 25 mm. into the tube without meeting with an obstacle. It is, however, difficult and painful to carry the probe beyond the isthmus of the tube. A uniform swelling, as well as a circumscribed constriction, can be recognized by opposing the introduction. The utility of the probe for either diagnostic or therapeutic purposes is not generally admitted.

The diagnosis of middle-ear disease is completed by full examination of nose and pharynx.

All ear instruments should be scrupulously cleaned after use, and all those coming into contact with diseased surfaces should be sterilized. For this purpose nothing is so satisfactory as boiling soda solution (see ¶ 30, Chap. III.).

**316.** *Paracentesis* (operative perforation) of the drumhead is often done for therapeutic, rarely for diagnostic purposes. The meatus is syringed to remove wax and scales and sterilized by a bath of at least three minutes' duration with a reliable disinfectant (3 per cent. solution of carbolic acid or carbolic acid in glycerin 12 per cent.). A needle or knife mounted on a shank at an angle of 140

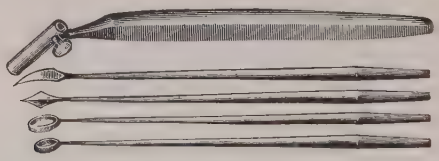


FIG. 123.—Paracentesis needle and knife for operation on drumhead, with universal handle for ear instruments; also two forms of curets for middle-ear surgery.

degrees (Fig. 123) is thrust through the drumhead, making a long vertical slit, of course under good illumination and through a wide speculum. The incision is preferably made where the membrane bulges most. Paracentesis causes a momentary sharp pain, especially when the drumhead is inflamed. It is not possible to produce local anesthesia by means of a watery solution of cocain, since this is not absorbed through the skin. Cocain dissolved in anilin oil (Gray) has likewise proved inefficient. A solution consisting of equal parts of cocain, menthol, and carbolic acid (Bonain) gives a partial and not always reliable anesthesia. As this mixture is slightly caustic, it should be applied cautiously on a minute pledget of cotton on a probe to the area to be incised.

A paracentesis properly done, and with aseptic pre-

cautions, is practically free from danger. There are on record a few instances in which the bulb of the jugular vein protruding through a defective floor into the tympanic cavity was wounded. The alarming hemorrhage

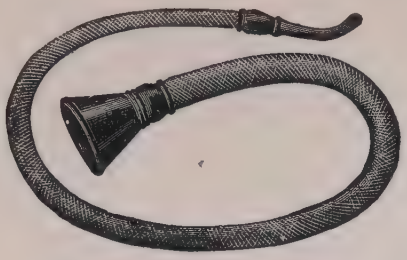


FIG. 124.—Conversation tube.

was controlled by a tampon in most instances. It is hence best not to cut down to the inferior rim of the drumhead. After paracentesis the syringe should not be used.

**317.** Defective hearing can be assisted by intensification of sounds by means of speaking-tubes or ear-trumpets (Figs. 124 and 125). Their underlying principle is the concentration of sound-waves in a funnel-shaped receiver. A simple hollow hard-rubber cone with soft-rubber tube leading into the ear is usually the most satisfactory pattern for listening to individual conversation. It is not possible to advise a patient which model he should select for general purposes. It is better to let him choose by actual trial of different patterns. As a rule, the larger, and hence the more undesirable, the trumpet, the more it collects the sound. Some patterns modify the timber unpleasantly. Small

FIG. 125.—London hearing horn.

contrivances are generally useless. The audiphone of Rhodes, a slightly curved fan of hard rubber held against the teeth as a resounding board, is a very convenient instrument, but is generally not found quite so useful as a trumpet.

All patients with progressive impairment of hearing should be advised to learn to "read" speech by watching the lips of the speaker. By proper and long-continued attention, begun while they can still hear fairly well, they will ultimately be able to compensate in part their deficient hearing by interpretation of the lip-movements.

## CHAPTER XXXIII.

### DISEASES OF THE EXTERNAL EAR.

**OTHEMATOMA. — PERICHONDRITIS. — ECZEMA. — DIFFUSE OTITIS EXTERNA.—FURUNCLES.—PARASITIC INFLAMMATION OF THE MEATUS.—WAX AND EPIDERMIS PLUGS.**

**318. Othematoma** is a localized swelling in the auricle due to extravasation of blood under the perichondrium. It forms a soft tumor of variable size, with some discoloration of the skin, usually in the upper part of the auricle, never in the lobule. It causes but little annoyance, but is sometimes tender to touch. It is, as a rule, due to blows upon the ear, hence seen mostly in pugilists. It was evidently more common among the fighters of classic antiquity, whose writers mention it and some of whose statues show the deformity which othematoma sometimes leaves. It is of remarkable frequency (about 1 per cent.) among the insane, in whom probably preceding degeneration of the cartilage predisposes to effusions of blood, perhaps even without trauma.

The effusion is underneath the perichondrium. It usually clots and sometimes becomes encysted. The smaller accumulations of blood are apt to disappear spontaneously in the course of many weeks. They may, however, leave some shrinkage and deformity of the cartilage, especially after recurrent attacks. The absorption can be favored by daily massage. When no favorable change is seen after the lapse of three or four weeks, an incision may be made into the cyst. But since reaccumulation is apt to take place, the cavity should be cleansed as far as is necessary with a sharp scoop and the wound packed with iodoform gauze.

**319. Perichondritis** of the auricle is very rare. It shows its inflammatory nature by diffuse doughy swelling, redness, tenderness, sometimes with considerable pain. The course is very tedious and lasts many weeks. The inflammation may disappear, or it may lead to abscess and phlegmonous sloughing. Its cause is usually not known, but it has been ascribed to syphilis in some instances. As long as there is no suppuration tincture of iodin and ichthyol may be applied locally. As soon as pus is suspected, it must be treated surgically.

**320. Eczema** is a frequent skin affection and the only common one involving the auricle and meatus. It begins in the form of minute vesicles, which spread at first rapidly and soon change into moist scabs covering an excoriated surface. It is usually seen in its chronic form and may persist indefinitely. The subjective annoyances are burning and itching. When seen in children, it raises the suspicion of scrofula, but it does occur as well in apparently perfect health, both in children and in adults. In the writer's experience the only prompt treatment has been the free use of nitrate of silver in strong solution—30 per cent. or the solid stick—to the excoriated surface after complete detachment of all crusts. The pain can be relieved by the previous application of cocain. The abraded surface becomes covered with a thin eschar, which blackens when exposed to light, and underneath this film regeneration of the epithelium takes place. Sometimes one application suffices to check the secretion, but mostly a few repetitions are needed. Wherever moisture is seen, the eschar should be detached daily and the surface brushed again until permanently dry. The persisting dry dermatitis and the liability to immediate relapses are effectually checked by the use of a salve of oil of cade (1 in 4 of lanolin stiffened by oxid of zinc). If objections are raised to the pain and blackening produced by the nitrate of silver, Peruvian balsam may be applied instead, but with less prompt effect. The various dusting-powders used for eczema

in other localities do not prove very serviceable on the auricle.

Eczema in the squamous form is sometimes limited to the interior of the meatus, producing distressing itching. With good illumination the skin is seen scaly, like dandruff on the scalp. There may be a trifling serous exudation which is apt to be fetid. Without careful inspection this skin disease is easily overlooked. In this form it yields very promptly to a salve containing 3 to 5 per cent. each of resorcin and precipitated sulphur. The relief of the intolerable itching is generally very gratefully acknowledged.

Itching in the meatus—the **pruritus** of some writers—may, however, be due to other conditions as well as eczema. It is sometimes dependent on vascular turgescence of the pharyngeal end of the Eustachian tube, and in such cases is more or less relieved by Eustachian inflation. Severe itching not due to eczema of the meatus indicates, as a rule, a neurotic disposition and may prove a serious puzzle to the therapeutist.

**321. Diffuse inflammation of the external meatus (diffuse otitis externa)** is recognizable by more or less swelling of the walls of the meatus, even to the point of complete occlusion, with variable and, indeed, sometimes very severe pain. There may be slight serous or seropurulent discharge, or none at all. The disease is not always the same etiologically. It is, of course, an inflammation of the skin, generally also of the deeper tissues of the meatus, due to the invasion by pyogenic microbes. In some cases it is the consequence of eczema; in others it results from scratching of the delicate skin of the meatus. Patients cannot be warned too emphatically against using hairpins and similar implements to relieve itching. Sometimes the apparently diffuse inflammation is really due to multiple but small furuncles. Again, it may result from irritating chemicals injudiciously dropped into the meatus. Sometimes a desquamative inflammation of the skin, with retention and secondary decomposition of

moist scales, starts the process, but in all instances care must be taken to determine the presence or absence of inflammation of the middle ear when the meatus is found swollen. When the swelling does not permit a view of the drumhead, this diagnostic question may have to be left in suspense.

The walls of the meatus are seen swollen, sometimes in actual contact, but are very little reddened. The greater the swelling, the more severe the pain and the more the patient complains of a fulness in the ear, with transient deafness. With cotton wound on a tooth-pick search is made for secretion. When the latter is purulent and thick, there is reason to suspect involvement of the middle ear. A thin but fetid discharge may come from the meatus itself. Minute coherent plugs of thick pus indicate furuncles.

In non-suppurative instances the writer has found no application equal to carbolated glycerin (10 per cent.) dropped into the meatus with a drop-tube and retained by a plug of cotton. The inflammation, which might otherwise last weeks, may thus yield in a few days. When the excoriated surface secretes fluid it should be syringed with sterile water through a fine cannula. If scales of skin cannot be dislodged by the current, they should be scooped out. After filling the meatus with carbolated glycerin a gauze drain should be introduced beyond the swelling to permit drainage. The aseptic drainage is especially important when suppurative inflammation of the middle ear is suspected. When the walls of the meatus secrete fluid the disease is likely to last at least a week under treatment.

**322. Furuncles** in the meatus, or **circumscribed otitis externa,** consist of minute cutaneous abscesses with a central slough. The affection is very painful. The furuncles are more often single than multiple. When healed, they are apt to recur unless guarded against. Sometimes a recurrence takes place after many weeks' interval. As a rule, no constitutional cause can be

learned. They may be due, however, to local traumatism by scratching. As the meatus contains atmospheric dust and probably always living germs, lesions of its delicate skin are apt to cause infection, especially by staphylococci.

The furuncle can be seen as a small, not well-defined swelling, exquisitely tender to touch, in the cartilaginous meatus. After a day or two it shows a small "head," which then breaks with some relief. The ear itself feels stuffy. The great pain which sometimes radiates over the entire side of the head may raise the (unfounded) suspicion of mastoid disease. Such a wrong diagnosis is in rare instances suggested by a puffy swelling behind the ear, due to a small abscess started by the furuncle. The correct diagnosis should be guided in these deceptive cases by the brief duration and the negative history (no previous middle-ear disease). Such a furuncular abscess may produce a febrile rise of several degrees.

As soon as the purulent contents can be recognized, the furuncle should be incised deeply with a sharp small bistoury. The incision is very painful, and no local application can prevent the pain. If the cut is made before the contents are soft, the throbbing pain of the furuncle is not relieved at once, although its course is shortened. Some relief can be obtained subsequently by filling the meatus with carbolated glycerin. It should then be packed lightly with a sterile gauze drain. It has been claimed that firm packing of the meatus with a thick tampon will, after a while, relieve the suffering during the early stage, but the writer cannot corroborate this. Recurrence of furuncles can be surely guarded against by filling the meatus once in a day or two with carbolic acid solution—either 3 per cent. watery or 10 per cent. glycerin solution. This should be kept up for several weeks.

**323. Parasitic otitis externa** or **mycosis of the meatus** is a rather rare occurrence, which is seldom observed in this country. It is due to the invasion of the

meatus by a mould fungus, usually a variety of aspergillus. It may cause no symptoms at all or more or less fulness and discomfort. The skin scales in flakes, sometimes forming casts on which greenish or black spots occur. These are recognized as a fungus upon microscopic examination. The disease is checked by a few instillations of alcohol containing 2 per cent. of salicylic acid.

**324. Impacted Cerumen.**—Ear wax, a yellowish, thick, oily substance, is secreted by the glands in the skin of the cartilaginous meatus and of a narrow zone along the upper wall of the bony part of the canal. Normally it dries in the form of soft but crumbling scales, which are gradually carried outward by the normal outward growth of the epithelium. The process can be shown by making a stain in the depth of the meatus with an anilin dye or nitrate of silver. It can then be seen traveling outward slowly in the course of weeks. The expulsion of the wax is also favored by the movement of the joint of the inferior maxilla communicated to the cartilaginous meatus. Under unknown circumstances the escape of wax is hindered and perhaps its rate of secretion increased. A necessary condition seems to be nasopharyngeal disease, either in the form of acute attacks or persistent chronic lesions. The wax accumulates without causing any annoyance as long as a narrow channel is still left. When this is filled up by further secretion or by swelling of the plug from water, the patient complains of fulness, impaired hearing, noises, and sometimes dizziness. Inspection shows the meatus filled with a formless mass of a color varying from light brown to black. The condition persists indefinitely, although sometimes the plug dries and falls out after a long period of time. A long persistence of impacted wax damages the ear permanently, though but to a slight extent. It probably leads to slight hypertrophic changes in the drum cavity. Wax plugs occur much oftener in both ears than in one alone. They are almost sure to recur in the course of months or years, but the presence of excessive wax seems

to be an assurance against the occurrence of any form of progressive deafness. On the other hand, absence of wax indicates always serious nutritive disturbances in the middle ear.

Wax plugs should not be removed with instruments, since traumatism, even with sterile instruments, may cause infection. Syringing is always sufficient. A large syringe, either a rubber bulb or a piston syringe, with thin but blunt nozzle, and sufficient patience are required. Coolness of the water or too much force may cause pain, dizziness, or even fainting. When the plug is difficult to dislodge, it can be softened by a strong solution of bicarbonate of sodium. Either a few repeated instillations each with an action of some five minutes may be employed, or the fluid may be left in the ear for hours after plugging with cotton. By the aid of its solvent action the wax plug can always be removed without injury. Any persisting feeling of fulness after removal is relieved at once by Eustachian inflation.

**325. Epidermis plugs** must be distinguished from wax plugs, both on account of their significance and the difficulty of their removal. They occur as often one-sided as double-sided. They consist of scales of detached epidermis and are distinctly laminated. They are often covered or interspersed with wax. The exfoliation is the result of a desquamative inflammation of the skin, which, by itself, may cause no unpleasant sensations. The presence of epidermis plugs may lead to infection of the walls of the meatus or middle-ear disease, and even to carious destruction of the bony walls of the meatus. Quite often the macerated scales contain germs causing decomposition and fetid odor. When epidermis scales are found in the external meatus, middle-ear disease should be thought of as a possible complication. Cholesteatoma of the middle ear sometimes extrudes into the meatus and may simulate or complicate the affection of the meatus. Epidermis plugs cannot always be removed by syringing alone, although this should be tried first.

They can be softened better by means of glycerin than by bicarbonate of sodium solution. When difficult to detach and requiring the use of instruments, it is well to fill the ear with carbolated glycerin, both for maceration and protection against infection. A tooth-pick dipped into a concentrated solution of caustic potash may be thrust carefully into the center of the plug in order to macerate and soften it. By the use of a blunt ear spatula, blunt broad forceps, blunt, sometimes even sharp, scoops, these plugs can be gradually picked out in the course of a few days if necessary. If the skin of the meatus appears macerated or inflamed after removal of the plug, it should be brushed with nitrate of silver solution (10 per cent.) until healthy. When this is done, epidermis plugs are not so likely to recur as wax plugs.

# CHAPTER XXXIV.

## DISEASES OF THE EXTERNAL EAR.

### FOREIGN BODIES. OPERATIVE DETACHMENT OF THE AURICLE. TUMORS. STENOSIS OF THE MEATUS. INJURIES. MYRINGITIS.

**326. Foreign bodies,** such as beads, peas, wads of paper, and the like, get into the external meatus mainly through the pranks of children. Cotton and gauze are sometimes forgotten and left. A variety of small objects, sticks of wood, and so on get in by accident, and insects —for instance, bedbugs and the larvæ of flies—have been found at times. As long as the foreign body is not sharp its mere presence causes no annoyance beyond, perhaps, a feeling of fulness, and it leaves no consequences. It is the traumatism, especially from unskilful attempts at extraction, which is to be feared. The inexperienced physician cannot be warned too emphatically that it is safer to leave a foreign body in the meatus for the time being than to take the chances of wounding the walls or the drumhead. No attempt to remove a foreign body should be made unless the latter is seen. If it be covered by wax, the removal of the wax is in order. If it is so small as to be hidden in the deep sinus of the meatus next to the membrana tympani, it will probably drop out when the head is turned to the side. Hence leisurely inspection through the speculum with a good light should establish the diagnosis before any therapeutic action is attempted. Prompt action is only required if traumatism, either incidental or due to former attempts at extraction, has led to complications. These may be diffuse inflammation of the walls of the meatus or inflammatory involvement of the middle ear. In the latter case extensive traumatism involves the risk of extension to the brain.

The safest way to remove a foreign body is by patient syringing with warm water. In the case of peas or beans, which swell when moistened with water, oil or alcohol may be used for syringing, unless they are freely mobile and can be made to drop out by turning the head. Live insects may be dislodged by tobacco smoke or chloroform vapor. Impacted objects which do not budge on syringing should be seized with the utmost care with a small sharp hook or a flat curet, with its blunt edge turned toward the wall, or the snare. The surgeon should always remember not to push the object deeper into the canal. Forceps of any kind are apt to do this. Good illumination is indispensable. In the case of an unruly child anesthesia may prove necessary. If the attempted extraction fails, it is sometimes better to desist for the time as long as there are no urgent symptoms. Under the use of carbolated glycerin moderate swelling of the meatus may recede sufficiently to permit an easier extraction a day or two later.

**327.** When other methods fail and urgent symptoms indicate prompt interference, the auricle and cartilaginous meatus are to be detached from the osseous canal in order to gain access to its depth. The typical operation is done as follows:

Vertical (slightly curved) incision down to the bone, 5 mm. behind the auricle from the tip of the helix to nearly the tip of the mastoid process. Compression or torsion of bleeding vessels. Detachment (by means of an elevator) of the periosteum and of the cartilaginous meatus from the bone. Transverse (vertical) section through the posterior cutaneous wall of the osseous meatus with the tenotome. By pulling the auricle forward, the cartilaginous meatus is almost entirely lifted out of the osseous canal, which is now accessible. Good illumination without reflecting mirror is all that is required. If the foreign body cannot be removed by reason of impaction, the osseous meatus is now enlarged by chiseling away its posterior wall with small concave gouges. After

completion the cartilaginous meatus and auricle are replaced and the external wound is sutured. If the posterior wall has been chiseled, the integument of the meatus is slit longitudinally for the purpose of better coaptation. The meatus is then packed with iodoform gauze. The operation is rarely required, except in the case of complicating inflammation of the middle ear or shot wounds.

**328. Tumors** of the external ear or of any part of the ear are not common. The most frequent growth of the auricle is the **fibroma** or **keloid**, sometimes the consequence of irritation by an ear-ring. Keloids are more often seen in negroes. **Sebaceous cysts** occur mainly on the concave side of the auricle. **Cancer** and **lupus** are rarely seen here. All these morbid processes present no peculiarities different from those in other localities.

In the meatus **polypi** are often seen, but they rarely spring from the walls of the meatus, mostly from the middle ear, and will be treated in connection with chronic suppurative otitis. The few polypi which originate from the walls of the meatus must be considered in the same manner as those extruding from the middle ear. The most frequent neoplasms of the meatus are **exostoses**. They may grow sufficiently to occlude the canal. Sometimes they are multiple. They are of ivory hardness, and must be removed by chiseling through the healthy bone around them. Their discussion can be combined with that of stenosis or atresia of the external meatus.

**329. Narrowing** or **occlusion** of the canal may be due to various lesions. Besides circumscribed exostoses, a diffuse hyperostosis of the osseous wall or at least of a part of it is sometimes seen, especially in connection with old chronic suppuration of the middle ear. Cicatricial contraction may follow an ulcerative process, such as corrosion by chemicals or burns or lupus, or, very rarely, diphtheritic inflammation of the meatus. It may also follow faulty healing after a radical mastoid operation with partial removal of the posterior wall of the meatus. Total occlusion of the canal is sometimes seen as a con-

genital condition, either in the form of a membranous diaphragm, or as total obliteration of the caliber. The former condition is recognizable by the yielding to the probe, while hardness of the obstruction shows it to be bony.

Narrowing of the meatus requires surgical attention if it either interferes with hearing or with the escape of the secretion of a diseased middle ear. The latter indication is imperative. Otherwise it may not be necessary to interfere. Mechanical dilatation and small operations are useless. Drilling by means of hand drills or burrs run by a dental motor or chiseling is permissible only on the anterior wall and only within the length of the meatus. Any encroachment toward the drumhead involves risk. In the case of exostosis or diffuse hypertrophy of the posterior wall the proper method is chiseling after detachment of the auricle. The hard growths can be shelled out by gouging through the normal bone. When working on the posterior wall it must be remembered that in the vicinity of the drumhead there is danger to the facial nerve and semicircular canals. Congenital occlusions are easily dissected out if membranous. In the case of total obliteration of the canal an operation is risky and of questionable utility. It should not even be considered unless tests with tuning-forks establish the integrity of the internal ear on that side beyond question.

**330.** Under the head of **accidents** to the ear **frost-bites** must be mentioned as the most common. Congelation of the helix or of the lobule causes a blanching, followed by persistent lividity. The popular practice of rubbing frozen ears with snow in order to thaw them gradually is probably founded on experience. The congestive reaction after a frost-bite may last a long time and is apt to return upon slight exposure. Nothing can be done for it beyond protection in cold weather.

**331.** The most frequent **injury** to the ear is that resulting from a blow. It may lead to ringing and slight deaf-

ness, without visible lesion of the drumhead. This may be due to a hemorrhage or merely a concussion of the labyrinth. The effects pass off in a few days at the most, unless the ear was previously the seat of a catarrhal process which is sometimes considerably aggravated. A blow may also cause a rupture of the drumhead. The same lesion is sometimes the result of explosions, and necessarily follows any direct traumatism by pointed implements. Traumatic ruptures of the membrana tympani are linear and show bloody suffusion of the edges. The hearing is temporarily impaired. They usually heal without reaction if not irritated or infected by injudicious treatment. Nothing beyond rest of the parts is called for. Syringing and applications are at least useless, if not injurious.

More serious is any traumatism of the drumhead which leads to bruising as well as to rupture. This may happen from the entrance of tree twigs or stalks or from unskilful manipulations in the meatus. The damaged drumhead often sloughs for a number of days with gradual enlargement of the perforation, and, of course, with suppuration of the middle ear. The treatment in such cases should be that of acute otitis (¶ 360).

When violence causes a **fracture at the base of the skull** it is apt to rupture the drumhead as well. The diagnostic sign of this accident is the discharge of cerebrospinal fluid, more or less bloody, through the meatus. If the patient survives, severe suppurative middle-ear disease is apt to follow. It should be guarded against in such cases by immediate asepsis of the meatus with carbolic acid solution and the introduction of sterile gauze drains as in the treatment of purulent otitis.

**332. Myringitis,** inflammation limited to the membrana tympani, is a rare occurrence which the writer has never seen in the acute form unless of traumatic origin. It is described by Politzer as a formation of small circumscribed blood blisters, serous vesicles, or even minute abscesses on the cutaneous side of the drumhead. It

causes more or less shooting pain, with scarcely any impairment of hearing, and heals, as a rule, within a few days. The vesicles may be pricked with a needle and the membrane dusted with boric acid.

**Chronic inflammation limited to the drumhead** is not quite so rare as acute myringitis, but is, as a rule, a secondary affection resulting from eczema or a desquamative dermatitis of the meatus, or is a sequel to suppurative inflammation of the middle ear. The drumhead appears cloudy, and its surface macerated and sometimes covered with moist scales. Politzer describes a papillary form in which the membrane is partly covered with minute granulations. The disease produces very little disturbance beyond slight discomfort and itching. After cleansing, boric acid powder may be blown in. If this produces a temporary watery discharge or if no improvement follows within a few days, a 10 per cent. solution of nitrate of silver can be tried. For the papillary form Politzer recommends brushing with tincture of chlorid of iron.

# CHAPTER XXXV.

## DISEASES OF THE MIDDLE EAR.

### CATARRH OF THE EUSTACHIAN TUBE.—SEROUS CATARRH OF THE MIDDLE EAR.

**333.** Diseases of the middle ear are divided into affections—(*a*) without and (*b*) with suppuration. The division is justified by the difference in the prognosis and therapeutic indication of the two groups. The non-suppurative group includes—

Catarrh of the Eustachian tube;
Serous or exudative catarrh of the middle ear;
Plastic or adhesive inflammation of the middle ear;
Sclerosis.

### CATARRH OF THE EUSTACHIAN TUBE.

Inflammatory obstruction of the Eustachian tube accompanies all inflammatory affections of the middle ear. But as a lesion limited to the tube, without primary disease of the middle ear, it is not commonly seen in adults, though very common in childhood. It is due in most instances to the presence of an enlarged pharyngeal tonsil (adenoid vegetations) and occurs in the course of subacute inflammatory processes involving the nasopharynx. In rare instances it is the result of an acute nasal catarrh without permanent enlargement of the pharyngeal tonsil, and under these conditions it is sometimes seen during adolescence. Any systemic disease accompanied by nasal or pharyngeal inflammation may be the remote cause of Eustachian occlusion.

The only manifest symptom of Eustachian obstruction in children is reduced hearing acuity. The impairment begins either acutely or, as a rule, more gradually, accord-

ing to the intensity of the nasopharyngeal inflammation. It remains more or less stationary for a variable or even indefinite period of time, and does not usually reach any high degree. Hypertrophy of the pharyngeal tonsil prevents, as a rule, complete spontaneous recovery, or leads to frequent relapses if the hearing has been restored temporarily. When the pharynx becomes normal after a transient catarrh, the Eustachian affection disappears entirely. The impairment of hearing is sometimes so slight that it is detected only by the child's inattention. Tests show that there is reduction of air-conduction only, not of bone-conduction. Both ears are always involved, though not necessarily alike.

Adults complain of a sense of fulness in the ears. Young children either do not feel or do not notice this sensation.

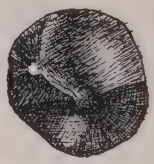


FIG. 126.—Retracted membrana tympani in Eustachian catarrh, with serous fluid in the middle ear. The level of the fluid is marked by a straight line.

Sometimes they admit it after being relieved by inflation. Occasionally sharp earache—especially one-sided—is complained of, most likely during the night. Although the cases with this pain follow the same course and yield equally rapidly to treatment as typical painless Eustachian catarrh, the pain is probably due to some slight lesion in the middle ear. This view is supported by the presence of vascular streaks—congested vessels—along the handle of the hammer, which are not seen in ordinary Eustachian catarrh.

The drumhead is normal in color and luster, but is distinctly drawn in. The handle of the hammer hence appears foreshortened (compare Fig. 2, Plate II.). In some instances, but not as a rule, an effusion of clear serum can be seen through the drumhead (Fig. 126).

**334.** A single successful inflation of the middle ear by Politzer's method or by means of the catheter removes all results of the Eustachian obstruction, except in long-standing disease with secondary lesions. The hearing becomes normal at once or in a few minutes; the fulness, if felt before, disappears, and the drumhead regains its normal position. If fluid is visible through the membrane, it is apt to be churned into foam, and air-bubbles can now be seen. The fluid disappears gradually by absorption.

Although there is but little opportunity to study the **pathology** of simple Eustachian catarrh in the dead-room, its nature and mechanism are clearly understood. Indeed, this knowledge is the key to our understanding and treatment of all the diseases of the middle ear which are complicated by Eustachian obstruction. The obstruction is due to swelling and venous engorgement of the mucous membrane at the pharyngeal end of the Eustachian tube. The immediate and often permanent results of inflation leave no doubt that the swelling depends mainly on serous infiltration—inflammatory edema—of the Eustachian lining. The imperfect postrhinoscopic view, which, as a rule, is all that can be obtained in children with adenoids, shows no gross change at the Eustachian orifice. The inflammatory process itself does not always extend into the tube. The assumption of some writers that adenoid vegetations can block the tube mechanically is not supported by actual examination of the naso-pharynx in the living or dead. When the Eustachian channel remains closed without periodic ventilation of the drum cavity, the air confined in the middle ear is gradually absorbed by the circulating blood in the vessels. The tension of the air in the drum cavity hence falls below the pressure of the external atmosphere. As a result, the greater pressure on the external surface of the membrana tympani forces this membrane inward. This faulty position of the drumhead is recognizable by the obliquity of the manubrium and the elongation of the triangular light

spot. This pressure upon the membrane is transmitted through the ossicles and oval window to the contents of the labyrinth, as can be shown by experimentation with a fresh specimen.[1]

The reduction of hearing is accounted for partly by the increased labyrinthine pressure, partly by the pressure exerted upon the chain of ossicles, which impairs their ability to conduct sound-waves. The diminished air-pressure in the tympanic cavity permits abnormal engorgement of the blood-vessels, which presumably extends into the Eustachian tube and exerts an unfavorable influence upon the morbid condition at its pharyngeal end. High degrees of this circulatory disturbance lead finally to an effusion of serum into the drum cavity. This is not an inflammatory exudate, but merely a transudate of the fluid of the blood. When tested after aspiration through a puncture of the drumhead, it has been found free from micro-organisms. It is evident that a single inflation of the middle ear will repair all the functional disturbances caused by Eustachian obstruction, as long as there are no structural changes present in the middle ear. When, however, the retraction of the drumhead has continued for long periods of time,—variable with the individual,—secondary changes do occur. The joint between hammer and anvil becomes fixed by the long-continued retraction of the handle, the faulty position of membrana tympani and ossicles becomes permanent, and some impairment of sound-conduction remains, with irreparable damage to the hearing.

The **treatment** of Eustachian "catarrh" by a single inflation results in a permanent cure in those instances in which the inflammatory process in the nasopharynx has subsided without leaving permanent lesions. The inflation anticipates the natural cure. When the Politzer method fails on account of the valve-like action of the "soggy" Eustachian mucous membrane, it is best to

[1] By putting a capillary tube into a semicircular canal and observing the rise of fluid in it upon pressing the drumhead inward.

inflate by means of the catheter. Sometimes a few repetitions are necessary in the course of a few days. But whenever structural changes of a permanent nature exist in the nasopharynx, such as hypertrophy of the pharyngeal tonsil, enlargement with chronic inflammation of the faucial tonsils or purulent rhinitis, the inflation gives relief only for a variable but short period, with certainty of relapse. A radical cure in such instances is obtained only after proper treatment of the pharyngeal or nasal affection.

## SEROUS OR EXUDATIVE CATARRH OF THE MIDDLE EAR.

**335.** Catarrh of the middle ear with effusion of fluid is found in nearly 10 per cent. of ear patients. It is much more common after puberty than in childhood. In young children predisposed to ear disease by an enlarged pharyngeal tonsil or other nasopharyngeal lesions low grades of inflammation do not usually extend far beyond the Eustachian orifice, while severer forms of disease lead to purulent otitis. Catarrhal otitis is double-sided in nearly three instances out of four, but quite often one ear suffers so little that the patient complains only of the other.

The disease begins acutely with a "full" feeling in the ear or through the head. The patient says the ear is "closed." In children earache may be present; in adults it is neither common nor severe if present. There may, however, be some pain on swallowing. Almost from the start deafness is complained of. But, as a rule, this is not so excessive on actual test as the patient claims. He is apt to be misled as to his hearing ability by the stuffy feeling. Tests show great differences in the reduction of hearing in different cases, from barely perceptible impairment to difficulty in understanding loud speech close to the ear. Bone-conduction is always intact. The patient's own voice sounds muffled to him. Noises in the ear may accompany serous catarrh, but do

not usually cause much annoyance, especially in the beginning.

Since the objective disturbances are in part due to the presence of fluid in the middle ear, the shifting of the level of the fluid on changing the position of the head may make a marked change in the discomfort, sometimes for the better, sometimes for the worse.

Dizziness is occasionally a distressing complaint. There are some exceptional instances on record in which grave cerebral disease was simulated by acute catarrh of the middle ear, especially in infants. Different otologists have seen a condition of coma or stupor, sometimes with convulsions, promptly relieved by the treatment of an acute catarrhal otitis. It is, therefore, sound practice to examine the ears in every case of obscure brain symptoms, especially in children.

The **course** of catarrhal otitis is variable and depends a good deal, but not exclusively, on the condition of the nose and pharynx. Very mild cases without permanent nasopharyngeal lesions recover spontaneously in two to three weeks. In more severe instances complete recovery is exceptional unless as the result of treatment. Without sufficient treatment the more acute symptoms may diminish, but complete recovery does not take place. Either some exudate remains in the drum cavity and the disease becomes subacute, with occasional acute relapses, or the changes in the mucous membrane assume a plastic character and the affection changes gradually to the type of chronic adhesive middle-ear disease. The former class of cases offer a much better prognosis in case of late treatment than the latter. A serious obstacle to recovery are permanent nasopharyngeal lesions, especially nasal stenosis.

**336.** The **lesions** found in accidental autopsies of catarrhal otitis are congestion and inflammatory swelling of the mucous membrane, with fluid exudation. The swelling may either be trivial or may be so intense as to obliterate part of the drum cavity. It may be confined to small

areas, especially on the internal wall or around the articulation of the ossicles, or it may be diffuse and even extend into the mastoid antrum, the lining of which is at least congested. The membrana tympani is, as a rule, but little altered. The swelling is due to infiltration of the mucous membrane with serum and round cells. The epithelium may be partly defective. Where the tumefaction of the mucous membrane brings different parts of its surface in contact with each other, adhesions may form which persist after the swelling has subsided. The movements of the ossicles may thus become permanently hampered. The swelling extends into the Eustachian tube, but not necessarily far beyond its tympanic end. Quite often the middle or even the greater portion of the Eustachian channel shows normal lining and structure. The pharyngeal end, however, is frequently found in a state of inflammatory swelling. Yet this condition is generally not recognizable on postnasal examination during life. The fluid in the drum cavity, variable in amount, is a more or less viscid, even slightly purulent, mucus. On opening the cavity it is sometimes seen to adhere very firmly to the walls. It may be so scant in amount as not to extend above the inferior rim of the membrana tympani, and hence may not be visible through the membrane. Upon withdrawal of the exudate by paracentesis it has been found to contain staphylococci and streptococci. The same microbes are also found in part of the cases of purulent otitis. Why they should lead to a superficial catarrhal inflammation in one case and to a suppurative process with tendency to involve the deeper tissues in another is not definitely known.

Catarrh of the middle ear is probably always secondary to an inflammation in the nose or pharynx. The primary trouble may have ceased by the time the ear is examined. Although the ear may become involved in the course of an uncomplicated coryza of sufficient intensity, the majority of cases present more permanent structural

changes in the nose or pharynx, which must be considered important determining conditions in extension of disease to the ear. In children the most important of these is hypertrophy of the pharyngeal tonsil. After adolescence this lesion, even when it does not recede, becomes less of a menace to the ear. In adults stenosis of the nose deserves especial attention as a factor in the production, as well as in the perpetuation, of aural catarrh. Subacute exacerbation of a diffuse purulent rhinitis in the course of chronic rhinitis or sinuitis is oftener the starting-point than uncomplicated primary coryza. Ozena is not a common, but sometimes an important, primary affection. Occasionally large tonsils seem to be of influence.

Exudative catarrh occurs not only in the typical uncomplicated form, but also in subacute spells of exacerbation in the course of chronic adhesive otitis. Details regarding this form of disease will be found in the description of adhesive otitis.

**337.** The **diagnosis** of exudative catarrh of the middle ear, suggested by the sudden impairment of hearing with feeling of obstruction, is based on the evidences of intratympanic exudate with swelling of the mucous lining of the drum cavity. The membrana tympani may show but little anomaly at first. Some vascular streaks may run parallel to the handle of the hammer, but a diffuse redness is foreign to this disease. The Eustachian obstruction, which is rarely absent, causes within a short time typical sinking in or retraction of the drumhead, as described under the head of Eustachian catarrh. The handle of the hammer appears foreshortened, on account of increased obliquity, the triangular light spot elongated. The luster of the membrane is apt to become dimmed in the course of the disease. In case of long duration the translucency of the drumhead diminishes. Exudation in the middle ear can be seen through the drumhead whenever it reaches appreciably above its inferior rim. Very often this is not the case. It requires strong illumination

in order to see it. The level of the fluid is marked by a line across the drumhead, usually dark ; sometimes, however, a bright reflection (compare Fig. 3, Plate II.). The line may be low down or high up. On account of the irregular shape of the membrane the line indicating the level of the fluid does not necessarily appear straight, as it really is, but may seem curved or bent. Below the level of the fluid the membrana tympani is darker, yellowish green or yellowish red. When the fluid can be recognized, the level is seen to shift with inclination of the head, while slowness of this motion indicates the viscidity of the exudation.

The Eustachian obstruction is apparent in the Valsalva experiment, but is not always revealed by inflation according to Politzer or by the catheter. On auscultation during the entrance of air a bubbling sound indicates the presence of mucus in the tube or fluid in the drum cavity. The sound varies from a coarse to a very fine rale. Its quality can be learned only by practice and not by description. Eustachian narrowness is revealed by a change from the normal faint clear blowing sound to a hiss or even a squeak. As a rule, the sound heard signifies but moderately impeded entrance of air, except in some protracted forms verging toward chronicity.

Of much diagnostic and prognostic importance is the subjective effect of inflation. In catarrh of the middle ear inflation improves the hearing and reduces the fulness invariably, but to a very variable extent in different cases. For the conditions described in the chapter on Eustachian catarrh (¶ 334) are always present—viz., diminished patency of the Eustachian passage, hence less regular or even abolished ventilation of the drum cavity, reduction of intratympanic air-tension by absorption, unbalanced pressure of the external atmosphere upon the membrane transmitted through the ossicles to the labyrinth, and congestion of the intratympanic blood-vessels. While all these mechanical disturbances yield to inflation, there exists, besides, inflammatory swelling of the tympanic

lining, causing more or less rigidity of the ossicular articulations, as well as a variable amount of fluid exudate. These latter changes are not influenced immediately by inflation. Hence the degree of immediate improvement resulting from artificial ventilation through the tube is inversely proportionate to the extent of the morbid changes in the drum. In some instances inflation is followed only gradually by an increasing improvement in hearing and comfort until the full benefit is obtained some hours later. The effect of Eustachian ventilation is not limited to the prompt relief of the mechanical anomaly. For by restoring the normal air-pressure in the drum an important factor in the maintenance of vascular engorgement is eliminated. There is every reason to assume that in the ear, as elsewhere, vascular congestion of mechanical origin interferes with the normal resolution of an inflammatory process. While in Eustachian catarrh a single inflation ends all disease manifestations, the effect of an inflation is only temporary when there is disease in the middle ear itself. The greater the immediate effect, the longer it will persist and the less complete will be the return of the previous symptoms. But in any case the effect of inflation begins to decline in the course of a day.

**338.** The **treatment** hence consists in the repetition of inflations at least once a day. In the mildest case complete recovery can thus be obtained in about eight to ten days. Inflation is often more efficient by means of the catheter than by the Politzer method, as judged by the immediate result. The Politzer bag may, however, be intrusted to the patient's hands, if necessary, though, as a rule, it is not to the patient's benefit to expect him to carry out any part of the treatment to which the surgeon ought to attend. Eustachian inflation generally stops promptly any earache in the earlier course of middle-ear catarrh. The pain can also be controlled by antipyrin.

In the less favorable instances the benefit of inflation is nearly or wholly lost within twenty-four hours. There

may even be occasional exacerbations in spite of treatment. In such cases it is best to advise the patient to use the Politzer bag several times daily. Extensive trials have been made to increase the effect of inflation upon the absorption of the inflammatory swelling and of the exudate by adding the vapor of iodin, chloroform, or oil of turpentine, or finely divided chlorid of ammonium, or hot air (¶ 315). It is very difficult to judge the efficacy of these measures in a given case, or even in a series of cases, on account of the positive, but somewhat variable, influence of the inflation itself, particularly, however, on account of the impossibility of foretelling accurately the course of an individual case. It cannot be said of any one form of vapor application that it has received decided praise by many except the original author. While it would be unjust to deny the utility of vapor inflations entirely or to refuse them some trial, it cannot be said that by their employment results can be obtained which are not possible without them. Chlorid of ammonium deserves perhaps trial more than any other substance.

The injection of a few drops of fluid into the tube through the catheter must be spoken of with less reserve (nitrate of silver solution 2 per cent. or zinc sulphate solution 0.5 to 1 per cent.). Its benefits are, at the best, doubtful. A few drops blown in do not penetrate beyond the tube, which is usually not diseased throughout its middle half. A larger quantity may cause and has caused suppurative otitis.

When fluid exudate persists in the drum without being absorbed and the disease is thus prolonged, it may be removed by a paracentesis (¶ 316). It is only in a small minority of cases of exudative catarrh that paracentesis is indicated, but when called for it is of decided benefit. When done aseptically, it causes no unpleasant consequences. After making a free incision the exudate is blown out by a Politzer inflation. If viscid, it may be seen adhering to the wound. Boric acid is insufflated lightly, and a piece of ab-

sorbent gauze is left in the meatus to absorb the fluid. Syringing must be strictly omitted after paracentesis. On account of the high position of the tympanic opening of the Eustachian tube fluids in the drum do not escape through the tube, except as the result of overflow. Suction through a flexible tube pushed in through the catheter is hence irrational. Exudates disappear by absorption when the tympanic mucous membrane is not too much diseased. But the presence of the exudate itself keeps up the inflammation of the mucous membrane.

The only other direct mode of treatment which can exert an unmistakable though feeble influence upon aural catarrh is pneumatic massage (¶ 313). It is of most service after the acuteness of the process begins to decline.

The persistence of catarrhal otitis in spite of local treatment is due in many cases to the persistence of the nasal or pharyngeal condition which started it. It must be remembered that the direct cause of extension to the ear is the nasopharyngeal inflammatory process. If this has subsided spontaneously, no nasal treatment is called for. But if the inflammation of the upper air-passages remains, its treatment produces a beneficial effect upon the ear proportionate to its influence upon the nose or throat. In proportion as we succeed in reducing purulent secretion and turgescence of the nasal cavernous tissue we will find an improvement in the ear. If the disease in the nose and pharynx can be made to yield to sprays, the douche, and medicinal applications, the aural lesion improves correspondingly. But if the persistence of the nasopharyngeal inflammation depends on the presence of permanent structural changes, such as stenosis due to septum irregularities, or hypertrophy of mucous membrane or of cavernous tissue, or pharyngeal adenoids, operative treatment is required in order to stop the morbid process both in the respiratory passages and in the ear. It does happen at times that the nasopharyngeal inflammation recovers completely in spite of a stenosis, and in such a

case the ear will also recover without nasal operation, but relapses are to be feared. On the other hand, our present means of treatment of nasal and pharyngeal diseases are not infallible, and hence a catarrhal otitis may drag on in spite of nasal treatment.

Aural catarrh will occasionally prove obstinate, even after disappearance of the nasopharyngeal affection. Recovery depends on the normal resisting power of the tissues. This may be enfeebled by a variety of other disturbances of the system—for instance, anemia, intestinal derangement, etc. Hence proper hygienic management must not be overlooked.

**339. Syphilitic Catarrh of the Middle Ear.**—Various observers have described occasional instances of severe middle-ear affections apparently due to syphilis, but neither their discordant reports nor a few scant autopsies suffice to establish a definite clinical type. I have personally seen some instances of a form of middle-ear affection which seemed to me peculiar to syphilitic patients. It was apparently a severe catarrhal inflammation of moderately acute onset, bilateral, with considerable impairment of hearing, much noise and fulness, and some dizziness. The impairment referred to air-conduction, not to bone-conduction. The drumhead was cloudy and sometimes slightly injected. Eustachian inflation showed diminished patency and the presence of a very scant exudate. Inflation, however, did not improve subjectively or objectively. Specific treatment likewise produced no noticeable benefit inside of two to three weeks. Unfortunately, none of the patients were observed for any great length of time.

## CHAPTER XXXVI.

### ADHESIVE OR PROLIFERATIVE INFLAMMATION OF THE MIDDLE EAR.

**340.** The names "adhesive, proliferative, plastic, or hypertrophic" otitis, or "dry catarrh" of the middle ear, refer to an affection of the middle ear which must be considered the analogue and extension of hypertrophic rhinitis. Very rare in early childhood, it cannot be called common until after growth is finished, from which time on its frequency increases until every third or certainly every fourth individual in advanced age presents some evidence of this disease. The disease is rarely one-sided—mostly bilateral. But quite often one ear is less affected than the other, sometimes so little that the patient calls his disease one-sided. The progress of the disease is not necessarily parallel in the two ears.

In typical cases it begins so gradually that its exact date of origin can often not be stated. Ringing in the ear, perhaps only occasional at first, may be ignored for a long time until it becomes annoying. Later on it may become the main complaint, more serious to the patient even than the deafness. In neurasthenics tinnitus can cause much suffering and unhappiness. "Stuffy" sensations are usually not present to any distressing extent except in complicated cases. Dizziness is likewise not a strictly "normal" symptom of adhesive otitis, but it does occur in a small proportion of cases on account of some special localization of the lesion or as a complication, and it may prove very distressing. The hearing becomes affected gradually. Sometimes the patient is not conscious of any impairment for many months; in other cases he is annoyed from the start. The impairment is, of course, most perceptible when listening to

faint sounds—for instance, in the telephone. The disease never ends in absolute deafness. Except in case of ankylosis of the stapes, loud speech can always be understood close to the ear. It may take years before the perception of ordinary conversation becomes embarrassing; but in those instances in which ankylosis between the foot-plate of the stirrup and the oval window takes place, the hearing is much more seriously compromised. This is, on the whole, not a frequent occurrence in adhesive otitis. It may begin early or late in the course, and when begun, it may reach its completion within weeks or within several years. When complete, it practically bars hearing of the voice, except through a speaking tube. It is a common observation in hypertrophic otitis that conversation is better understood in noisy surroundings, like railroad cars, etc., than where silence prevails.

Tests show that a faint whisper is not heard normally even at a time when the patient claims normal hearing. As a rule, the perception of the watch is more impaired in this disease than that of the voice. Tuning-fork tests show air-conduction diminished, especially for low tones, for which bone-conduction is normal, or later on even increased. In Weber's test the sound is localized in the more affected ear, except in cases complicated with lesions in the internal ear. Rinne's test shows impaired air-conduction; later on its normal formula becomes reversed, especially for low tones (Rinne negative).

The **course** of proliferative otitis is variable. It is only a small minority of cases that continue to get worse steadily. This severe course is favored by pronounced hypertrophic rhinitis with nasal stenosis; but it may happen, too, even without nasal obstruction. On the other hand, a fair majority of patients lose their noises and feeling of stuffiness and retain their hearing for a time without further continuous impairment. The disease has apparently come to a stand-still. The damage done to the hearing is usually permanent, as a rule, even under treatment. This apparent arrest of the disease is

in most cases not permanent. With a fresh "cold" in the nose the symptoms return to a variable degree. Whether or not the loss of hearing power is steadily progressive can be judged only by the history during a period of at least some months. But the presence of other symptoms, tinnitus, fulness, or discomfort of any kind, is evidence of the progressive character of the disease. Yet a permanent arrest of the disease is not so very rare. It can be expected only if the irritative symptoms are either of recent origin, or if of longer duration, have not been continuous. The younger the patient when the disease began, the less probable is a favorable termination.

**341.** The clinical course of proliferative otitis is **complicated** in some instances by a slight degree of exudative catarrh. A small number of cases of exudative catarrh change gradually into the plastic form, and thenceforth present the combined lesions of hypertrophy with mucous secretion into the drum cavity. Others do not give the history of acute onset, but pursue a mild, subacute course from the beginning, with considerable variation in the degree of exudative inflammation in consequence of changed environment or as the result of treatment. This "mixed" type of middle-ear disease is aggravated by every fresh "cold" in the nose more so than the purely proliferative form without secretion. But, on the other hand, it is also more readily influenced favorably by treatment. In adhesive otitis, but especially when some exudation is present, the patients claim to hear worse in bad weather. The complaint is not always corroborated by actual test. The patient is at times deceived as to his hearing power by the subjective feeling of fulness or the tinnitus which may be increased by unfavorable weather.

**342.** The **morbid changes** in plastic otitis consist of inflammatory swelling, hypertrophy, fibrillary sclerosis, and adhesions of the mucous membrane. In the pure type of proliferative inflammation the lesions are often localized, especially around the articulation of hammer and anvil. When exudation is present, the process is

more likely to be diffuse. The exudate, if present, is scant mucus, sometimes very viscid. Diffuse inflammatory swelling occurs probably only during subacute exacerbations, or in the case of exudative catarrh gradually changing into a plastic otitis. Ordinarily more or less circumscribed hypertrophy of the lining is found, the surface being uneven, sometimes with papillary or villous prominences. The articulations may be imbedded in hypertrophied mucous membrane. As a result of much thickening, the protruding prominences of the lining come into contact and form adhesions, especially between the joint of hammer and anvil and the opposite walls. In other instances the membrane is not hypertrophied, but transformed into relatively rigid fibrous tissue. It has no longer its normal delicacy and pliancy, but binds down the mobile parts which it envelops. Instead of broad adhesions of mucous membrane, narrow rigid adventitious bands are found bridging from one surface to another. There is no good reason to consider this fibrillary sclerosis as the later transformation of hypertrophy of the mucous membrane. It is more likely the result of imperfect involution of inflammation under unknown conditions. The mobility of the hammer is reduced, and its normal position changed into one of increased obliquity, which is maintained partly by adhesions, partly by contraction of the ligaments and of the tensor tympani muscle. The latter may be shortened by fibrillary transformation or bound down by adhesions. The proliferative changes may extend to the round window, thickening its diaphragm. When the disease attacks the vicinity of the oval window, it leads to ankylosis of the foot-plate of the stirrup, the most serious lesion possible in the middle ear so far as sound-conduction is concerned. Even a partial involvement of the articulation by fibrillary transformation of the tissues damages its function. In complete ankylosis the foot-plate is bound down by rigid fibrous tissue, sometimes with interstitial deposition of lime-salts. Bony ankylosis does not often take place in

proliferative otitis; more so, however, in disease of the bony capsule of the vestibule (see ¶ 350).

The Eustachian tube is involved in this disease, at least at its tympanic end. In all probability the Eustachian lesion is the primary one in plastic otitis. Morbid changes are found, as a rule, in the bony (tympanic) portion of the canal, while the cartilaginous part of the tube internal to the isthmus is mostly normal. The lesions correspond to those in the middle ear—viz., diffuse thickening of the mucous lining, or fibrillary sclerosis with concentric narrowing, sometimes adhesions, often valve-like overlapping of the tympanic opening by a fold of mucous membrane. Circumscribed cicatricial strictures like those found in the urethra do not seem to occur in the tube. The pharyngeal portion of the Eustachian lining shows more or less inflammatory swelling (leukocytic infiltration) or permanent hypertrophy, according to the character of the primary nasopharyngeal lesions.

**343. Etiology.**—Proliferative otitis is the extension of chronic nasal inflammation into the middle ear. It is never observed when seen at the start, except in connection with chronic nasal disease. If the latter heals as the result of changed environment or treatment, the lesions of adhesive otitis may persist in the ear—apparently independently; but the loss of hearing is, as a rule, not progressive. The nasal etiology is illustrated strikingly by the coincidence of the first or more affected ear with the narrower side of the nose in the case of one-sided stenosis. There are, however, some rare exceptions to this rule. Fluctuations in the degree of nasal inflammation are usually accompanied by similar variations of the condition of the ear, especially when we review longer periods in the patient's history. The dependence of the ear disease upon chronic rhinitis is demonstrable in some instances by the arrest of the former by nasal treatment. There are, however, various reasons why this therapeutic test is not always successful. Nasal treatment, even operative, however successful it may be, does not, as a

rule, eradicate all chronic inflammation of the nasal mucous membrane. It only removes the annoyance caused by the rhinitis, but the diseased membrane still remains in a state of slight chronic inflammation. Moreover, an actual hypertrophy of mucous membrane once produced is a permanent lesion. It is only the inflammatory swelling which is transient; the thickening of the mucous membrane not due to round-cell infiltration, but to real hyperplasia does not disappear spontaneously or in consequence of treatment. It can hence not be expected that any changes in the middle ear beyond those of inflammatory swelling should disappear, even after the influences which brought them on have ceased. Besides, when permanent changes in the Eustachian tube have reduced its patency, either by relative stenosis or by rigidity of its mobile portion, the deleterious consequences of reduced intratympanic air-pressure persist even though the nasal lining were again made normal. If, at the same time, the tympanic mucous membrane has begun shrinking by fibrous transformation, further reduction of the mobility of the ossicles and fixation in a faulty position are inevitable.

While a simple chronic rhinitis without coarse structural changes or stenosis is sufficient to start plastic otitis media, the course of the latter is apt to be hastened and intensified by nasal stenosis or circumscribed hypertrophies. This view, suggested by the observation of any large series of patients with a variety of nasal lesions, is often confirmed by the beneficial results of nasal operations when done at an early stage of the ear disease.

**344.** The **diagnosis** of proliferative otitis is based—(*a*) on the results of the functional tests showing reduced air-conduction, with normal or exaggerated bone-conduction; (*b*) on the appearances of the drumhead; and (*c*) on the evidence furnished by inflation. The membrana tympani, normal at first, gets dull and opaque in most instances. Its luster becomes dimmed. Chalky white spots of calcification are not rare, but these

changes in the membrane, although indicative of plastic inflammation, do not permit any conclusions as to the hearing or the progress of the disease (Figs. 127–129; compare also Fig. 4, Plate II.). They may coincide with normal hearing and arrested disease, while, on the other hand, in an unfavorable case the drumhead is sometimes not altered structurally at all. In

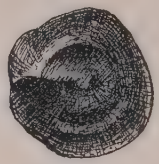


FIG. 127.—Pronounced retraction of drumhead in chronic hypertrophic middle-ear catarrh with Eustachian stenosis. The membrane has nearly its normal luster, but is discolored and less translucent than normally. Instead of the normal triangular spot there is a crescentic reflex figure.

subacute exacerbation there may be a vascular streak parallel to the hammer, but ordinarily the membrane is pale. Of decisive importance is the change in the shape of the membrane. Retraction of the drumhead with obliquity of the handle of the hammer characterizes the majority of instances. It is indicative of impaired

FIG. 128.—Drumhead cloudy, discolored (thickened), and moderately retracted in long-standing chronic proliferative middle-ear disease.

FIG. 129.—Cloudy and thickened membrana tympani with spots of calcification in chronic proliferative catarrh of the middle ear.

Eustachian patency, which is always incident to the course of the disease. There are exceptional cases in which the Eustachian patency is not demonstrably diminished in the earlier period, and the drumhead may then have its normal position. But if the tube is found normal after a history of active disease for months,

this fact would change the diagnosis for that of "sclerosis."

Inflation by Valsalva or Politzer shows diminished patency of the Eustachian tube in this disease, when it affects the two ears unequally. When symmetric on both sides, the obstruction is not noticeable in this manner until quite pronounced. The catheter, too, gives a sound, usually from the very beginning, indicating narrowed caliber, of course, most appreciable on comparing two sides not equally affected. The Eustachian obstruction is never sufficient to prevent inflation by the catheter, but it may finally make the Politzer method inefficient. The diagnosis of slight secretion as a complication must be based entirely on the auscultation sound on inflating, as there is no other evidence of it.

The effect of inflation varies according to the predominance of Eustachian obstruction or of plastic changes in the drum. The latter are not influenced, while the mechanical disturbances of tubal closure are temporarily relieved. There may thus be a fair subjective improvement of more or less duration, but never so striking as in exudative catarrh. On the other hand, inflation may have no effect whatsoever. The result of the first inflation determines the prognosis. The greater the subjective improvement, the more reason to assume that the changes in the tube and drum are still capable of resolution. The prognosis, however, depends even more on the duration of the benefits of Eustachian inflation than on their immediate degree.

Inflation does not always clear the ears at once: some patients feel the subjective improvement only after the lapse of some hours. The immediate results of inflations cannot be gauged merely by the improvement in the hearing. This is never so marked as in exudative catarrh; indeed, mostly not very striking at all, often not measurable objectively. But the effect on the tinnitus and on any fulness felt in the ear is the test of its beneficial influence. When thorough inflation through the

catheter gives no subjective relief, either at once or in the course of some hours, there is nothing to be gained by its repetition.

**345.** For the purpose of **treatment** inflation should be practised daily as long as it influences the hearing or the discomfort of the patient. Longer intervals in the treatment mean a waste of time. As soon as inflation fails to improve the condition for at least a few hours, it is useless to continue it. Sometimes its period of usefulness is over after a few weeks of treatment; in other instances it is of some benefit in staying the disease during months. The fluctuations of proliferative otitis may demand a repetition of inflation when the disease gets a fresh start. While it will generally be found that catheterization is more effective than the Politzer inflation, yet the latter may be left to the patient as an additional help. Many persons can learn to catheterize themselves, if required. The final results of a course of inflation are very variable, depending largely on the transient or permanent character of the constricting lesion in the Eustachian tube, and of the changes in the drum cavity. They can be predicted with moderate certainty from the effect (and especially its duration) after the first inflation. The utility of vapors—turpentine, iodin, chloroform, or finely divided powders (freshly formed chlorid of ammonium)—injected through the catheter has been discussed in ¶ 338. As a rule, critical comparison does not show any pronounced advantage over simple inflation, and even in the apparently favorable instances a true appreciation of the value of these agents is very difficult. Dilatation of the Eustachian tube by sounds introduced through the catheter has not been found useful by many observers, although recommended by some. It is painful to reach the osseous portion, which is usually the part involved. Moreover, there is no reason to expect a permanent benefit from the transient pressure by the probe.[1]

[1] Recently electrolysis of the Eustachian tube has been highly indorsed for the cure of inflammatory narrowing (Duel, Kenefick). Through a well-fitting

Pneumomassage (¶ 306) of the drumhead and ossicles is, as a rule, subjectively agreeable. Its long continuance, about one to two minutes, twice daily, is often of some little influence upon the hearing and the noises. Yet its value is enormously overrated in some reports. If a few tests do not show very decided benefit, it is more appropriate to let the patient keep up the exercise at home for months than to force him to come to the surgeon's office.

How much benefit may be expected from nasal treatment in hypertrophic otitis can be inferred from the etiologic discussion in ¶ 343. In instances of relatively short duration,—months,—and especially in those characterized by rapid course and fluctuations in the severity of the aural symptoms, a decided improvement will often follow the successful operation of nasal lesions. Removal of septum deformities, snaring of hypertrophies of the inferior turbinal, cauterization of excessive cavernous tissue, either anterior or posterior, and especially galvanocaustic destruction of vascular prominences at the rear of the septum (¶ 94 and ¶ 97) give at times very satisfactory results, both as regards improvement of hearing and disappearance of tinnitus and fulness. But such fortunate instances constitute only a small minority and

Eustachian metal catheter insulated on its external surface by means of rubber an olive-tipped gold wire, 1 mm. wide at its bulbous end, is pushed into the tube until it enters nearly or quite up to the middle ear (about 35 mm. beyond the end of the catheter). As soon as resistance is encountered, the gold wire is made the negative pole of a battery current of $\frac{1}{2}$ to not over 4 milliampères in strength. The positive pole may be a sponge or a bowl of salt water into which the patient dips his hand gradually in order to avoid a shock. This current is employed for a few minutes. During its action the probe glides easier through the narrowed Eustachian passage than previously. Inflation must not be practised for at least a day for fear of causing emphysema. It has been claimed that in many instances decided relief from the tinnitus and fulness follows the first application, and the hearing may improve correspondingly. A few repetitions in intervals of some weeks are said to have given permanent results in many instances. The method has not yet been tried sufficiently by others to test its value. Personal trial has shown me that in spite of care and antiseptic precautions a mild grade of suppurative otitis may be caused by it.

cannot be foretold with certainty. Of most cases, however, it can be said that nasal treatment will tend to arrest the ear disease in proportion to its result upon the nasal disease. It must again be emphasized that in hypertrophic rhinitis operations which relieve the patient subjectively do not necessarily restore the normal state of the nasal mucous membrane, and that, indeed, our therapeutic control over this disease is limited. But, on the whole, all measures benefiting the nasal affection give the ear the best chances possible for the arrest of the disease. This applies not only to operations and medicinal treatment, but equally to all hygienic measures referred to in ¶ 14 to ¶ 17. But in spite of all care, the prognosis is doubtful in many instances, even at the beginning, and bad in most advanced cases. The history of steadily progressive deafness with tinnitus not controllable by inflation, the demonstration of Eustachian stenosis, and the absence of gross lesions in the nose give the therapeutist little chance for successful intervention.

## CHAPTER XXXVII.

### OPERATIONS FOR THE RELIEF OF DEAFNESS DUE TO ADHESIVE PROCESSES IN THE MIDDLE EAR.

**346.** The uncertainty of treatment in hypertrophic disease of the middle ear has led to various operative attempts.

A striking observation is the exemption of those ears from any form of progressive deafness in which there is a permanent perforation of the drumhead. When this is one-sided, the ear does not even participate if the other ear with intact drumhead becomes gradually deaf from plastic inflammation. In view of the frequency of hypertrophic middle-ear disease this exemption is quite remarkable. As long as a middle ear with perforated drumhead still continues to suppurate the hearing is occasionally further damaged by subacute exacerbations. But after the suppuration has ceased, the hearing of such an ear remains stationary. It is self-evident that a perforation in the drumhead prevents all the pernicious consequences of Eustachian obstruction. Observations on ears with healed suppuration but persisting defect in the membrane suggest, moreover, that even those intratympanic changes which so often occur in connection with but moderate impairment of the Eustachian patency are secondary to the latter. It would hence be a perfectly justifiable operation to make a permanent fistula in the drumhead in all cases of beginning middle-ear catarrh, if we only knew of any method to maintain a permanent perforation. It sounds paradox that we cannot imitate nature in the example she sets in every chronic purulent otitis. In the latter case the edges of the perforation are cicatrized and covered with epithelium, and

the hole is permanent and can be closed only artificially. On the other hand, every attempt to maintain a permanent perforation by exsecting a piece of or even the whole drumhead or by inserting a cuff-button-shaped cannula or clamping a U-shaped perforated tube around the manubrium mallei has proved a failure. When the tendinous insertion of the membrane in its bony frame is chiseled away, regeneration is often, but even then not always prevented. The preventive operative treatment of chronic middle-ear catarrh is hence a matter of the future. There is no good reason, however, to believe that a permanent perforation would necessarily prevent the continuance of adhesive and ankylotic processes in the middle ear after they have been well started. In advanced cases of middle-ear catarrh some temporary relief is sometimes, but not always, obtained by puncturing the drumhead.

A different procedure was suggested by observations in chronic purulent otitis rebellious to conservative treatment. It has been found that the removal of the ossicles, together with the drumhead, does not often damage the impaired hearing, but, on the contrary, is quite apt to improve it, sometimes to a striking extent. In favorable instances ordinary conversation can be well heard in the absence of the drumhead, the hammer, and the anvil, although, of course, the hearing is far from being perfect. Attempts have, therefore, been made by many surgeons to remove these parts in progressive deafness due to plastic processes without suppuration. The operation, moderately painful, can be tolerated without general narcosis only by a courageous individual. Cocain is of service only after the drumhead has been opened, not before. Suprarenal solution is of considerable help in suppressing troublesome hemorrhage. The operation through the meatus is feasible only when the latter is normally wide. Otherwise preliminary detachment of the cartilaginous meatus would be necessary (¶ 327). The most advantageous illumination is that by an electric lamp on

the forehead. The drumhead is detached from its insertion by a curved peripheral anterior and a similar posterior incision from above downward. A fine bent knife then severs the tensor tympani tendon and the joint between the long processes of the anvil and the head of the stapes. A delicate snare is pushed up until it grasps the head of the hammer, and with cautious prying movements the latter is taken out. If the anvil does not follow, it may then be searched for with the snare, or with small, variously bent hooks. The removal of the anvil is not easy, and sometimes impossible. Under absolute asepsis and the avoidance of syringing there is very little reaction and no suppuration. The after-treatment consists only in placing a sterile gauze tampon into the meatus. With thorough knowledge of the anatomy the only accident to be feared—and that not a common one—is injury to the stapes. In the latter case severe dizziness may ensue for days. Severe purulent otitis may occur in case of imperfect asepsis. Through carelessness the facial nerve may be wounded.

**347.** There is no doubt that the operation has influenced the hearing favorably in a small proportion of cases. In a larger number of instances the distressing noises have been permanently benefited. It cannot be learned with certainty from published reports whether the hearing remained stationary in any large number of instances after this operation. Very few cases seem to have been watched for a sufficiently long time. On the other hand, in a minority of instances the tinnitus was not benefited, and in a large majority no gain accrued to the hearing power, while not rarely the latter was seriously damaged. The operation has been abandoned by many former enthusiasts; still, it does not deserve to be unreservedly condemned, but it should be understood that its prognosis is absolutely uncertain. In a number of instances the moderate benefit temporarily obtained was lost after the membrane became regenerated.

**348.** Tenotomy of the tensor tympani muscle has been

practised considerably in former years, sometimes with some temporary benefit, but has now been abandoned as inefficient.

The removal of the ankylosed stapes has been done quite a number of times, especially by Blake and Jack. The hammer and anvil need not necessarily be removed in this operation, but, of course, the drumhead must be partially detached. As a rule, there is severe reaction in the form of dizziness, if the foot-plate of the stirrup is really removed by the operation. Although some benefit has been claimed, this delicate operation has not gained favor among otologists.

In relatively rare instances an adhesion of the drumhead or even of the manubrium to the internal tympanic wall results from a destructive purulent otitis. In such cases a moderate benefit to the hearing, but especially a relief of tinnitus, may be obtained by dividing the adhesions with a minute knife bent on the flat.

**349.** Abnormal relaxation, with flaccidity of the membrana tympani, is sometimes met with from unknown causes, perhaps at times from imprudent repetitions of Valsalva inflation by the patient. Occasionally, too, large cicatrices of the drumhead are seen to be flaccid and possess abnormal mobility when tested with the Siegle pneumatic speculum. This condition reduces the hearing without other symptoms. In such rare instances an improvement in the hearing can be obtained by rendering the drumhead more tense by a coating of collodion. Whenever the condition returns by reason of the collodion peeling off, the membrana tympani may be brushed again with the solution.

## CHAPTER XXXVIII.

### "SCLEROSIS OF THE MIDDLE EAR" (RAREFACTION OF THE CAPSULE OF THE LABYRINTH).—ANKYLOSIS OF THE STAPES.

**350.** It had been noticed by even the earlier otologists that there is a certain type of progressive deafness which, while it resembles "dry catarrh" of the middle ear, differs from it sufficiently to be distinguishable clinically. On account of false pathologic ideas this disease has been termed sclerosis of the middle ear. Its true pathology has now been so completely demonstrated (by Politzer, Siebenman, and others) that an accurate differentiation is possible. Although an affection of the sound-conducting parts, it is really not a disease of the mucous membrane of the middle ear.

The disease begins usually between the fifteenth and twentieth years of life, less often later on, predominantly in females. It occurs in rather less than 5 per cent. of ear patients. It is always double-sided, and, as a rule, without much difference between the two ears. A hereditary tendency to ear disease is often found in the family. The hearing becomes gradually dulled, with very little other annoyance. No fulness, no stuffiness, no dizziness. Tinnitus is sometimes complained of to a moderate extent; it is neither constant nor steady. In the course of some years it becomes difficult to follow a conversation. In some the deafness does not proceed beyond considerable embarrassment in ordinary speech. In others it is steadily progressive, and after many years practically bars the patient from social intercourse.

These patients have no catarrhal history. During their younger years they are conspicuously free from nasal and pharyngeal disturbances, and their rare attacks of coryza

heal promptly. Later in life slight chronic changes may occur in the upper respiratory passages in unfavorable climates. The drumhead is normal at first. It may become slightly retracted, but not necessarily so. It often looks atrophic by reason of the special prominence of the neck of the hammer. The luster is normal. A pinkish hue due to congestion of the promontory is often noticeable through the translucent membrane, and is of inauspicious significance. The Eustachian tube is normal. Functional tests show reduced air-conduction, the result of fixation of the foot-plate of the stapes. Rinne's test soon becomes negative. The tuning-fork on the vertex is heard abnormally long. The main distinction between this form of disease and proliferative middle-ear disease is the pronounced deafness for the lowest tones of the scale when heard through the air. The range of audition is shortened by one to even three octaves at the lower end. In the course of years these tests become less decisive as the disease is likely to become complicated by involvement of the auditory nerve-ends. This is then indicated by shortening of the upper end of the auditory range on testing with the Galton whistle.

Sooner or later the disease ends in complete ankylosis of the stirrup—bony union of the foot-plate of the stapes to the walls of the niche in which the oval window is located. It is not yet certain whether this condition can be invariably recognized by means of Gelle's test (¶ 309). When the bony ankylosis is complete, the deafness usually ceases to increase. In some instances, however, the hearing continues to suffer even beyond this period, and the functional tests then indicate involvement of the nerve-ends in the labyrinth.

**351.** It was formerly supposed that this type of disease was due to fibrillary degeneration of the tympanic mucous membrane—hence the name, sclerosis. This supposition was entirely wrong. The tympanic mucous membrane is normal in this disease. The real lesion is disseminated rarefaction of the bony wall of the labyrinth. Separate

small yellowish foci are found, especially in the neighborhood of the oval window. In these spots the compact bony substance is changed into the cancellated type. The rarefaction is indicated by the presence of lacunæ and of osteoclasts. Enlarged and newly formed vessels render these foci abnormally vascular. Later on minute osteophytes form both on the tympanic and on the intralabyrinthine surfaces. This secondary proliferative process culminates in bony ankylosis of the foot-plate of the stirrup. It is doubtful whether the process can be called inflammatory. It is a return to the embryonic condition of the bone from unknown causes. We know nothing of the etiology beyond the frequent family predisposition.

So-called sclerosis cannot be influenced *therapeutically* by any known means. Eustachian inflation is sometimes agreeable subjectively, but has no permanent influence and is even accused of being harmful in the end. The same may be said of massage. Excision of the ossicles or operative manipulation of the stapes only can be condemned on the basis of experience. No internal medication tried up to the present time—iodids, thyroid gland, phosphorus—has given any decisive results. It is generally believed, perhaps on doubtful evidence, that the disease is least likely to progress rapidly when the health is maintained at par.

**352. Ankylosis of the stapes** is a not infrequent lesion in proliferative middle-ear catarrh, as well as in so-called sclerosis, in which it is a constant terminal feature. In the former disease it is usually not a bony union. There may be true sclerosis of the deeper periosteal layer of the mucous membrane, causing fibrous rigidity, and this may be complicated by more or less calcification or even partial ossification. The lesion necessarily causes a high degree of deafness. It is indicated by the reversion of Rinne's test, by exaggerated bone-conduction and total deafness for aërial sound-waves of low frequency. When in Gelle's test increased air-pressure in the meatus

does not reduce the perception of aërial sound-waves, the diagnosis may be considered assured.

In most instances of stapes ankylosis due to proliferative catarrh of the middle ear the diagnosis of the catarrhal origin can be easily made. There are exceptional instances in which the functional tests indicate stapes rigidity at a very early period, while the other symptoms do not as yet point to any extensive proliferative changes in the middle ear. Such cases are sometimes difficult to distinguish from so-called sclerosis. The latter, however, is always bilateral, while in the former type of disease it is not uncommon to find one-sided instances with very little involvement of the other ear.

Ankylosis of the stapes may also be the consequence of a purulent otitis. If the latter has healed without leaving visible evidences in the membrana tympani, as sometimes happens in childhood, the diagnosis of the origin of the ankylosis may prove puzzling.

## CHAPTER XXXIX.

### SIMPLE OTITIS MEDIA (PURULENT OTITIS MEDIA WITHOUT PERFORATION).

**353.** Suppurative inflammation of the middle ear is distinguished from catarrh by the greater depth of the inflammatory infiltration, which may even extend into the bone, and by the nature of the exudation. The latter varies from clear serum to pure pus, but is not the more or less turbid mucus of catarrh. Purulent otitis has hitherto been identified with a clinical picture beginning with well-defined pain and leading to a perforation in the drumhead, with subsequent discharge through it. But while this is the predominating type of the disease, there are other forms which have as yet received less attention.

It has been shown that a purulent inflammation of the middle ear is found at autopsies in about four-fifths of all dead nurslings. There is in this case the same discrepancy between the frequency of the lesions found in the dead-room and the scantiness of clinical observation which has been noticed in diseases of the nasal accessory cavities. Kutscharianz, Kossel, Ponfick, and others have shown this remarkable liability to purulent otitis in infants during their last days of life, apparently independent of the cause of death. The exudate has been found to contain the familiar pyogenic microbes, streptococci, staphylococci, and pneumococci, as well as in some instances the influenza bacillus. While all evidence points to invasion through the Eustachian tube, which at this age is relatively wide and short, the nose and pharynx were found normal in many instances.

In nurslings dying shortly after birth Aschoff found frequently lanugo hairs and vernix caseosa in the drum

cavity, presumably through the entrance of amniotic fluid into the Eustachian tube during swallowing movements of the fetus. On the basis of this observation he considers at least some of the instances of infantile otitis as an inflammatory reaction, due to the presence of foreign bodies in the middle ear.

This otitis, complicating so many of the diseases of early infancy, is clinically latent when the child is very sick and apathetic. In other instances it is suggested by restlessness and tossing of the head. A sudden rise of temperature may be due to it, as it has been shown that puncture of the drumhead may lower the fever during the course of other ailments complicated by concomitant otitis. It has also been pointed out (Ponfick-Barth) that this purulent otitis with escape of pus through the Eustachian tube can account for intestinal disturbances observed in such children.

It is not easy to diagnose this inflammation of the ear in the infant. The small meatus permits only the use of the smallest speculum. Very strong light is hence required. The meatus is apt to be filled by epidermis scales, which it is better to scoop out gently than to remove by syringing. The drumhead, very oblique at this age, is not easily distinguished from the posterior upper wall of the meatus. It is relatively little congested, but more turbid on account of the exudate than normally. It is yet to be determined by future observations how much this concomitant otitis, with its nearly latent course, adds to the danger of the disease which it complicates. Whether or not to puncture the drumhead is also an open question. There certainly should be more systematic attention paid to the ear of all sick babies.

Entirely different from this almost latent form of concomitant otitis is the ordinary purulent otitis, with perforation, which can occur in infants at the earliest age, and which presents the pronounced symptoms to be described in ¶ 356.

**354.** A latent form of purulent otitis seems to be the invariable rule in all cases of measles even when no pronounced aural symptoms are observed. In every fatal case of that disease examined by Bezold and his assistants the middle ear and mastoid pneumatic spaces were found filled with pus. Yet the great majority of patients with measles present no clinical symptoms of ear disease. In scarlet fever various observations on a more limited scale have also shown at least a frequent coincidence of a clinically latent purulent effusion into the middle ear. The same statement applies in diphtheria.

**355.** *True pyogenic inflammation* of the middle ear, which, however, does not lead to perforation of the drumhead, is observed at times in children and somewhat less frequently in adults. It begins with slight fever and sharp pain. The pain, however, is not continuous, but intermittent, generally worse at night. Fulness and deafness increase gradually during a few days, and when the climax has been reached, the pain subsides. The drumhead is either uniformly reddened or at least congested in its upper posterior portion (compare Fig. 5, Plate II.). Auscultation during inflation shows the presence of fluid in the middle ear. During healing this fluid becomes absorbed.

This form of otitis without perforation (which is not generally recognized) has been described by Politzer as a type of disease not identical with the ordinary perforating form of otitis. According to my experience, it is really but a milder type of the same disease which usually causes the drumhead to give way, but perhaps with a different localization. It occurs mainly in connection with the milder forms of nasal or pharyngeal disturbances. Coryza or tonsillitis, especially in the presence of adenoids, may lead to involvement of one or both ears. It may last from one to more than two weeks. The distinction between this form and purulent otitis tending to perforation is based at first upon the intermittent character of the pain. The distinction is not a difficult one

when the drumhead is only partially injected, but uncertain when it is diffusely vascularized. Subsequently the diagnosis is established by the subsidence of the symptoms without perforation of the drumhead. The disease differs from exudative catarrh by the more pronounced inflammatory symptoms at the onset. After these have subsided the difference between this form and acute catarrh is not so pronounced. The exudate, however, usually scant, is never as tenacious as the catarrhal secretion.

The tendency to recovery is decidedly aided by rest and protection and Eustachian inflation. The symptoms may, indeed, subside as promptly after a single inflation as they often do in exudative catarrh, but like in the latter instance, they increase again until the next treatment. Inflation stops the sharp pain at once. Instillation of carbolated glycerin (10 per cent.) seems to help in shortening the duration. After a few days of treatment inflation sometimes seems without further influence. Pneumomassage, while less effective in its immediate influence, is, however, of some benefit until the hearing becomes normal. Politzer warns against paracentesis of the drumhead. This, indeed, is usually unnecessary. But with the more recent methods of guarding against secondary infection through the meatus by absolute asepsis and gauze drainage paracentesis does not involve the risk of protracted suppuration, which Politzer cautions against as the danger attending puncture of the drumhead in this disease. The operation may hence be done when the case does not show a steady improvement under treatment by inflation, provided inflammatory symptoms or intratympanic exudation persist.

## CHAPTER XL.

### ACUTE PURULENT OTITIS MEDIA (WITH PERFORATION OF DRUMHEAD).

**356.** Acute suppurative inflammation of the middle ear is a disease prevalent at all ages, but most common in childhood on account of the predominance of its causes during that period. As the course of the disease is quite variable according to its etiologic conditions, it is best to begin with a review of its causes.

The disease is caused by the invasion of the middle ear by pyogenic microbes. In more than one-half the cases it is the pneumococcus, next to it, the streptococcus, less often, the staphylococcus, occasionally, the pneumobacillus (Friedländer), the colon bacillus, or the bacillus pyocyaneus. As a rule, only one variety of germs is present originally, but in neglected cases streptococci and staphylococci may come in as secondary infection. The invasion takes place mostly from the nasopharynx through the tube. Much less common is the infection from the external meatus in consequence of traumatism, such as careless removal of foreign bodies or plugs of wax, or as the result of extension of eczema. Cold water entering through a previous perforation of the drumhead may also rekindle an otitis. The most frequent starting-point of the disease is acute nasal catarrh. It is popularly believed, and not improbable, that the extension through the tube may be due to "taking cold." But simple uncomplicated coryza does not often infect the ear unless aided by other conditions. In nurslings this may be teething. In older children the presence of an enlarged pharyngeal gland is the predominating factor more than any other. Later in life nasal

stenosis favors the spreading of suppurative rhinitis to the ear of the same side. These predisposing conditions play the same rôle in connection with the nasal inflammation accompanying eruptive fevers. One of the most frequent underlying conditions is scrofula, but its influence depends largely on the existence of the enlarged pharyngeal tonsil so common in this affection. Suppurative otitis, often quite severe, may result from the entrance of water through the tube while using the nasal douche or while diving. Acute tonsillitis is not a rare cause. Diphtheria leads to clinically manifest otitis only in a small proportion of cases, but when it does occur, it is of a severe type. It is more often the streptococcus than the diphtheria bacillus which reaches the ear in diphtheria. Scarlet fever infects the ear often, and, as a rule, severely; measles much less frequently, at least clinically manifest, and generally not so severely. Rhinitis during small-pox, typhoid fever, or pneumonia may likewise extend to the ear. Influenza produces relatively often ear trouble, either a streptococcus otitis or a special form of influenza otitis, which will be described separately. Nasopharyngeal inflammation does not always extend along the lining membrane of the tube to reach the ear. In some cases the infection travels through the lymph-spaces. If purulent otitis does ever occur through direct infection of the middle ear by way of the blood-current, it is certainly not common.

Of the various causes of otitis, simple nasopharyngeal inflammation leads, as a rule, to the mildest type, especially in young children. The ear disease following scarlet fever and diphtheria represents, on the other hand, the most severe and destructive form. Of the various causative germs, the streptococcus produces the most severe infection.

**357.** The **morbid changes** are those of purulent inflammation in general—viz., inflammatory swelling of the mucous membrane, with partial destruction of the

epithelium and with abundant secretion of serum, seropurulent fluid, or thick pus. The most purulent form of discharge is usually due to streptococcus infection. The process may be very superficial or may extend into the periosteal layer. In the latter case secondary caries or necrosis of the bony walls or of the ossicles may follow in severe instances. In all but the mildest cases the inflammation extends into the mastoid antrum, and, as a rule, the same discharge is found in this cavity as in the tympanum. The attic is probably but little involved in the case of mild superficial lesions, while in unfavorable instances it may be the principal, or at least the most persisting, seat of the disease.

**358.** Acute purulent otitis begins with sudden fever, the height of which is variable, depending somewhat on the preexisting local or systemic disturbance which caused the otitis. The fever does not, as a rule, last long, especially in adults. A subsequent sudden rise of temperature, however, indicates some new extension—for instance, the deeper involvement of the mastoid process. The accompanying febrile disturbances, malaise, loss of appetite and so forth are somewhat variable, but generally not severe.

In very rare instances severe symptoms may occur which simulate brain disease, especially in children. Stupor, delirium, even convulsions are sometimes due to otitis without cranial complication, and cease as soon as the drumhead is perforated. Examination of the ear should be imperative in all obscure instances of apparent brain disease, especially in children who cannot tell of their earache.

The predominating **symptom** is pain,—earache,—often very severe and radiating, generally with more or less headache (one-sided). There is tenderness around and behind the ear, extending underneath the jaw, and often pain on swallowing. The pain lasts until the discharge finds its way through the drumhead. In severe cases, however, pain may persist for hours or even days

after perforation. The persistence of pain with tenderness over the mastoid region should arouse the suspicion of mastoiditis. In the most destructive instances of otitis during scarlet fever pain is sometimes conspicuously absent, or at least not mentioned by an apathetic child, which important fact should not be forgotten by the general practitioner. Pain is likewise absent, as a rule, in relapses of suppurative otitis in ears with a persisting perforation in the drumhead. The ear feels full and stuffy until well along in the course of recovery. There is rarely any tinnitus, but this sometimes follows for a while after the cessation of discharge. The hearing may be but little affected during the first day or two. . Subsequently it becomes dull in proportion to the severity of the disease. There is but little improvement in the hearing by the time the discharge has ceased. But it can be safely predicted that normal hearing will return in the course of weeks, perhaps as late as six weeks after the attack, except in the case of extensive destruction or neglected treatment.

Perforation of the drumhead with the appearance of discharge gives relief to the pain, as a rule, but not invariably. Perforation rarely occurs in less than thirty-six to forty-eight hours; exceptionally as late as the fourth or fifth day. It cannot be too strongly emphasized that the discharge is in most instances *serous* at first. If not properly drained, it is apt to become purulent after a few days in all but the mildest cases. This change is partly due to insufficient drainage, as it can be prevented by a properly maintained gauze drain. Later on the purulency is often the result of secondary infection by other bacteria invading the fluid in the meatus. It is possible and it should be the aim of the surgeon to *keep* the serous discharge serous and *not to let it get purulent.* In many severe instances, however, especially those due to streptococci, the discharge is purulent when it first breaks through the drumhead, or even when a relatively early paracentesis is performed. Still, in even such

instances it is an open question whether opening the drumhead at the very start would not have shown a serous effusion. The discharge may be very profuse—as much as several ounces in twenty-four hours. After two to three days it begins to diminish gradually in quantity.

The drumhead is uniformly and deeply injected from the start (compare Fig. 7, Plate II.). All details of structure are effaced; the manubrium is generally not distinct. Sometimes circumscribed purulent pouches appear (Fig. 130). The spontaneous perforation is generally not larger than a pinhole, and occurs mostly behind the umbo, often quite high up. In inflammation localized principally in the attic the perforation occurs in the flaccid portion or Shrapnell's membrane, and

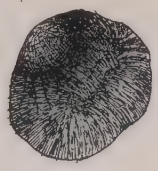


FIG. 130.—Acute otitis; membrana tympani congested, especially in upper posterior quadrant, serous infiltration almost effacing all landmarks. Circumscribed bulging in upper posterior quadrant.

this region may remain reddened longer than the rest of the drumhead in such cases. In the destructive forms due to scarlet fever or diphtheria and those following traumatism the hole in the membrana tympani is apt to grow by sloughing of its edges. In other forms this is rarely the case. The drop of fluid seen in the perforation pulsates. When the discharge is thick, a view of the perforated drumhead can be obtained only after cleansing by syringing or mopping with cotton. In the course of recovery the drumhead gets pale, but often remains thickened and cloudy (compare Figs. 8 and 6, Plate II.). Small perforations close almost invariably if the disease does not become chronic; even large holes do so very often. Drainage through the perforation is in rare instances interfered with by a singular unfavorable change

—viz., a nipple-like prominence of granulation tissue, with a narrow fistula in it which projects from the hole in the membrana tympani. This occurs often in disease of the attic with perforation through Shrapnell's membrane. It is best to remove this nipple by means of the snare, or even a small galvanocaustic burner (Fig. 131).

The duration of the disease varies with the etiology, severity, and to some extent with the age of the patient, and especially with the treatment. In a teething baby the earache of one night may be followed by three days of discharge and recovery. An attack of moderate severity in a grown-up child or adult rarely lasts less than ten to fifteen days, and often three to four weeks if the discharge is allowed to become purulent. Indefinite perpetuation

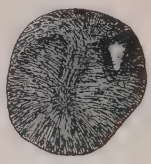


FIG. 131.—Membrana tympani in acute purulent otitis after a spontaneous perforation has become obstructed by granulations in the form of a pouting nipple. This projection is hollow, and there is a drop of pus at its orifice. The membrana tympani is cloudy and thickened, but its congestion is beginning to subside.

of the disease in the chronic form may happen in almost any case. It is least likely in very young children; most likely in adults. Mild cases are, as a rule, self-limited, but when the disease is due to scrofula, measles, scarlet fever, diphtheria, or influenza, or when the patient is ill-nourished or anemic, spontaneous termination is much less likely. Adenoid vegetations and nasal stenosis, as well as chronic nasal suppuration, favor persistence and relapses. Suppuration of the attic is especially liable to become chronic. Chronicity can in every case be prevented by appropriate treatment, which may in some few instances include a mastoid operation.

**359.** Of **complications** of purulent otitis, acute mastoiditis is the most common. All but the mildest forms

of inflammation of the middle ear are accompanied by some inflammation of the mucous membrane of the mastoid antrum. This condition may be clinically latent, or if more severe, may reveal itself by more or less tenderness over the mastoid region. In favorable cases this subsides gradually, but in some it may increase until finally the indications of disease of the mastoid bone appear in the form of pain, tenderness, redness, and external swelling. The detailed description will be given in the chapter on Mastoiditis. Paralysis of the facial nerve is a very infrequent complication, but is sometimes due to a destructive lesion in the bone. The facial palsy ends in recovery after the lapse of a number of weeks, or even some months. Intracranial complications are much less common in acute than in chronic purulent otitis. The small fatality of acute purulent otitis, probably much less than 0.5 per cent., is mainly due to meningitis. The symptoms of meningitis may exceptionally, however, be simulated by the ear disease itself, and disappear when the pus escapes. Cerebral abscess is even less frequent than meningitis. Thrombosis of the lateral sinus with pyemia is likewise a remote possibility, not nearly so common as in the course of chronic ear disease. Yet, however unlikely these complications are, they add some gravity to the prognosis of any individual case. The symptoms of these complications will be found in Chapter XLV.

**360.** The **treatment** of acute purulent otitis is efficient only if based on the surgical principles applicable in the management of suppuration in general—viz., drainage and prevention of secondary infection. All other forms of treatment are to be condemned as inferior. The patient should be put at rest during the acuteness of the symptoms. After they have moderated and drainage has begun, there is no further advantage in complete quietude. The pain ceases mostly as soon as the discharge can escape, though it sometimes persists for a while after perforation. The pain may require palliative

treatment. Its radiation and the accompanying headache can usually be controlled by antipyrin. Severe earache itself may necessitate morphin or opium. Hot applications (the hot-water bag or the Japanese stove) often give some relief. The only local application which sometimes mitigates the pain before perforation is carbolated glycerin (10 per cent. solution). In mild cases of otitis permanent relief is sometimes seen after the use of this fluid in the form of a prolonged ear-bath. But this is true only of those instances which do not end in perforation of the drumhead. Whether the use of carbolated glycerin can mitigate the disease so as to avert perforation is an open question. All popular ear drops, camphorated oil, laudanum, and the like, are entirely useless and delay necessary intervention. Eustachian inflation may give momentary relief, but is never of any permanent benefit. It has been severely condemned—perhaps unnecessarily so—by many recent observers as dangerous on the ground that it may carry the infected material into hitherto healthy spaces.

Paracentesis should be performed at once as soon as all hope must be abandoned of regarding the case as one of non-perforating otitis. When severe pain has lasted without intermission for more than about eight hours and the diagnosis is apparent by the uniform redness of the drumhead, it is the safest and wisest plan to puncture immediately. The operation is free from danger, requires no special skill, gives quick relief, and assures the shortest possible course. It should be done with the broad paracentesis needle or bistoury (Fig. 123) in the most prominent part of the membrane or in the inferior posterior region. When the disease is limited to the attic, as shown by the localized vascularity, Shrapnell's membrane should be divided horizontally. Too large an incision is better than too small a cut. There is a momentary sharp pain, which cannot be prevented by anything except general narcosis, which, as a rule, is superfluous. The bleeding is insignificant. Before

the paracentesis the meatus should be cleansed of wax and dust by syringing, and thereupon sterilized by filling it and the concha for at least three minutes with a solution of carbolic acid in water (3 per cent.) or in glycerin (10 per cent.). After paracentesis the meatus should be packed with a strip of sterile gauze about 1 cm. wide and 10 to 15 cm. long, pushed through the (sterilized) speculum gently with a flat probe. The entrance to the meatus and the grooves in the auricle are then loosely filled with strips of gauze until enough of a pad has been formed to absorb the most copious discharge for at least half a day. If necessary, this is held in place by a narrow strip of adhesive plaster across the auricle. As often as the external pad of gauze gets moist it should be replaced, which the patient can do himself. The strip in the meatus should be replaced only by the surgeon at intervals of one or two days. As it is impossible to assure asepsis by means of sterile gauze alone, various antiseptic additions have been tried, which, however, must be non-irritating. Chinolin-naphthol gauze is lauded by some. The writer has been well satisfied with a powder of boric acid mixed with one-sixth of salicylic acid dusted freely into the meshes of the gauze. A freely absorbing gauze must be selected, since the object of the dressing is to remove the discharge as fast as it forms. When the fluid is serous, this is easily accomplished. A change of serous discharge into pus indicates inefficiency of the surgeon's antiseptic precautions and means a serious prolongation of the disease. When the fluid is purulent from the start, the strip of gauze in the meatus must be changed oftener, in order to maintain a continuous flow from the middle ear to the surface of the absorbing pad. Syringing is of no benefit whatsoever in this disease. If done with ordinary water, it may even cause secondary infection. Syringing with sterile water or salt solution is less harmful and may sometimes be called for when thick discharge has not been properly absorbed by the dressing. In the case of purulent discharge maceration of the skin

of the meatus is at times annoying. The skin should be cleansed by mopping with wet and subsequently with dry sterile cotton and brushed with a 2 or 4 per cent. solution of nitrate of silver. Anointing the wall of the meatus with a thick zinc oxid ointment is also of service. The regular dressing should thereupon be replaced in the usual way. As the discharge diminishes, the amount of gauze may be lessened and the intervals of dressing lengthened. By the time the fluid has become scant, its secretion usually ceases abruptly. In cases properly treated according to this method from the start relapses of the disease are almost unknown and complications quite infrequent. When the discharge has ceased, the hearing is, as a rule, still very much impaired. Spontaneous recovery follows, however, in the course of weeks without further treatment. After closure of the perforation Eustachian inflation and pneumomassage are sometimes of some service.

When spontaneous perforation has occurred, the mildest and shortest possible course can be expected only if the same mode of dressing is begun while the discharge is still serous. If it has changed into pus, either from the continued influence of the original germ or by secondary infection after other germs have entered through the meatus, a more prolonged course must be expected and complications are more to be feared. As soon as the patient is seen after the spontaneous perforation, the meatus should be cleansed by aseptic syringing and an effort may be made to combat secondary infection by a prolonged ear-bath with carbolated glycerin. The previously described dressing should then be applied, and the case managed as detailed in the preceding paragraph. Any deviation from these rules will only result in a less favorable course.

After spontaneous perforation and occasionally after a paracentesis made too small or narrowed by a nipple of granulation tissue, the acute symptoms will, in exceptional instances, persist or return until a larger puncture

is made in the drumhead. When this treatment, properly carried out, does not result in the steady subjective improvement and diminution of discharge in the course of about two weeks, it is safe to assume that there is destruction going on within the mastoid cavity, even if there are no external symptoms of mastoiditis. This arbitrary period of about two weeks does not refer to the length of the disease or to its original date, but only to the time during which its symptoms are absolutely stationary under treatment. In such cases no cure can be obtained until the mastoid antrum is opened.

**361. Influenza Otitis.**—During the extensive epidemics of influenza for some years before and after 1890 a peculiar form of middle-ear inflammation was often met with early in the course of that disease. It was due to the invasion of the tympanic cavity by the influenza bacillus. It began with intense pain, often radiating in the form of a diffuse neuralgia, and with much fulness and often dizziness. Objectively it was characterized by hemorrhages in the drumhead and presumably the tympanic mucous membrane. Spontaneous perforation of the membrane did not always occur. When it did perforate or when it was tapped, the discharge was a bloody serum. In spite of its apparent severity this form of influenza otitis usually ended favorably in about two weeks or less if not interfered with by any active treatment. Paracentesis was generally not necessary or beneficial. Of late years this form of disease has become uncommon. It is well known that the entire clinical history of influenza is changing, either on account of altered virulence of the bacillus or on account of partial immunity of the population. Nowadays the usual form of influenza otitis is a late severe streptococcus infection of the middle ear, with the ordinary clinical course of an intense otitis.

## CHAPTER XLI.

### MASTOIDITIS.

**362.** The mastoid antrum participates in all severe forms of purulent inflammation of the middle ear. This has been shown by autopsies, and is strongly suggested as well by the copious secretion found in many forms of purulent otitis, too copious indeed to be furnished by the small area of the tympanic cavity. This inflammation of the mastoid mucous membrane may not reveal itself at all clinically, or it may be indicated by pain and tenderness over the mastoid process. This superficial inflammation, however, limited to the mucous membrane, is not the pathologic basis of what is ordinarily called mastoiditis. Whenever symptoms occur which the clinicist interprets as mastoiditis, they are due to an extension of pyogenic inflammation into the bony substance of the mastoid process, complicated often, but by no means always, with caries or necrosis of the bone. In very rare instances an abscess is limited to some of the cells underneath the antrum and does not extend into the latter.

Primary mastoiditis is very rare and is probably an osteomyelitis of the mastoid bone. As a rule, mastoiditis is secondary to purulent otitis media. In rare instances it follows that disease after an interval of many weeks after apparent cure of the otitis. As a rule, it is a complication during the continuance of an acute otitis with purulent discharge, sometimes beginning suddenly with a chill, more often developing gradually. In a small number of instances of severe otitis, especially the streptococcus variety, mastoiditis pursues an insidious course, with gradual abatement of its acute symptoms, continuing in a chronic, but none the less dangerous, form.

This almost latent form sometimes changes into a more acute disease. Mastoiditis is apt to be very destructive in diabetic patients.

Clinically manifest mastoiditis complicates but a small percentage of cases of acute otitis—probably considerably under 5 per cent. It is not quite so frequent in children as in young adults. It is noticeably infrequent among negroes. The direct cause is not clear. It is not usually due to occlusion of the aditus, for this is quite commonly found patent during operation. A large antrum seems of predisposing influence. The germs found in the pus are the same as those in acute otitis (¶ 356).

**363.** Mastoiditis rarely begins with a chill and a rise of temperature during the subsiding fever of otitis. As a rule, it simply prolongs the otitic fever in an atypical manner. Quite often it causes no rise of temperature. The characteristic symptoms are pain over the mastoid region and tenderness. The former, variable in degree, is rarely absent, but may subside while the destructive process continues in the mastoid. The tenderness is more constant. One-sided headache is rarely absent. As the inflammatory process extends through the bone toward its surface, edematous swelling and, later on, congestion and inflammatory edema of the soft parts behind the ear become pronounced. Of great significance, too, is the steady continuance of the discharge from the ear, without diminution, even if the other symptoms should be less marked or receding. An infallible, but not constant, sign is the bulging of the posterior upper wall of the meatus, sometimes with marked redness.

In its course mastoiditis may present the following possibilities:

1. It may end in recovery without perforation of the bone.

2. It may lead to a subperiosteal abscess.

3. It may perforate through the bone—(*a*) on the external surface; (*b*) on the anterior surface (posterior wall

of the meatus); (*c*) on the internal surface of the tip, or (*d*) the inflammation may extend through the bone to the cranial contents.

4. It may become chronic.

**364.** Recovery without perforation is probably the most common termination in all those instances of mastoiditis in which there is no destruction of bone. This fortunate turn becomes less and less probable when pain and tenderness have continued about a week. It may be excluded after pronounced inflammatory edema of the soft parts has lasted for more than a day or two. Edema without congestion does not preclude it. Distinct bulging of the posterior upper wall of the meatus is a sure sign that such recovery is impossible.

**365.** A subperiosteal abscess as a sequel of mastoiditis is sometimes seen in children; less often in adolescence. The pyogenic infection extends outward from the antrum through the squamomastoid fissure, which closes later in life, or perhaps through vascular channels. The abscess does not communicate with the mastoid antrum. As a rule, the symptoms of mastoiditis are very mild in such cases. The primary otitis may even have ceased when a subperiosteal inflammatory swelling appears over the mastoid process, generally some distance behind the ear. When this is properly opened, it heals kindly. In correctly diagnosticated cases the opening of the mastoid bone is entirely uncalled for. It is, however, sometimes impossible to distinguish between these comparatively innocent abscesses and the more serious spontaneous perforation through the bone. When distinct and protracted symptoms of mastoiditis have preceded the accumulation of pus under the soft tissues, it is well to make the incision large enough to search for a fistula in the bone. In early childhood and in those instances in which an early perforation indicates a thin bony wall of the antrum the patient may do quite well after a simple incision down to, but not into, the bone. But in older patients and in the case of narrow long fistulæ the heal-

ing is more protracted and the course not so free from danger as after a proper opening into the bone.

**366.** Impending perforation is indicated by inflammatory swelling of the soft parts behind the ear. They may be thickened to three or four times the normal extent. The ear may stand out nearly at a right angle to its normal plane. By carious corrosion of the bony wall the pus finds its way from the antrum to the exterior of the bone, raises the periosteum, and after the lapse of a good many days breaks through the skin. There is in such cases at least a carious fistula leading into the antrum. There may be necrosis of a small or large area of the external plate, or there may even be a sequestrum in the antrum. The latter is usually filled with spongy granulations which bleed freely on touch. The pus found in the cavity is thick and creamy. It may be scant, but more often a large or morbidly enlarged antrum contains it in abundance. In severe instances the destructive inflammation extends throughout all the pneumatic spaces of the entire bone. In rare cases the antrum itself is not involved, the disease being limited to some cells in the mastoid process below the antrum. When perforation has taken place through a narrow fistula without free drainage, the dangers of mastoiditis are merely lessened, but not removed.

Perforation through the anterior wall into the meatus does not take place often, even where bulging of the wall of the meatus shows the action of pent-up pus. When an opening occurs through the anterior boundary of the mastoid antrum, the pus is more apt to burrow underneath the cartilaginous meatus to the exterior than to appear in the meatus itself.

In the case of a markedly pneumatic mastoid process the inflammation may extend throughout all the cells to the tip, and if the inferior inner wall is thin, perforation can occur here underneath the sternomastoid and scalenus muscles. This relatively infrequent occurrence is known as Bezold's perforation. The pus burrows under-

neath the muscles and cervical fascia, forming a deep abscess. If this does not open spontaneously or is relieved by the knife, it may extend into the anterior or posterior mediastinal space, with fatal result. With deep incision and good drainage the prognosis is otherwise not bad, provided the mastoid process be well opened.

**367.** The greatest danger of mastoiditis is the extension of pyogenic infection upward. This may occur even after spontaneous perforation outward if the pus does not find free exit. Sometimes a carious spot is formed in the roof of the antrum. In other cases the inflammation extends through the thin or even normally defective plate of bone, separating the antrum from the posterior cranial fossa. The possible consequences are phlebitis with bland or purulent thrombosis of the lateral sinus, serous or purulent meningitis, subdural (epidural) abscess, or intracerebral abscess. The description of these diseases will be found in Chapter XLV. In children the thicker antral roof makes the upward extension much less common than in adults.

**368.** In a small number of instances the acute symptoms of a mastoiditis subside wholly or in part without recovery, and the inflammation continues in a chronic form. There may or may not be some pain left. The tenderness, however, disappears. The only symptom is the persistence of the discharge from the ear, which resists all forms of treatment except opening of the mastoid process. This chronic condition may continue indefinitely as a form of chronic purulent otitis, but is apt to exacerbate at times in a subacute form. In these cases the mastoid process is often found sclerotic, probably in consequence of the long-continued inflammation.

**369.** The *treatment* should be, in the first place, preventive. The liability to mastoiditis is least when a purulent otitis receives proper attention and drainage from the start. In my own experience clinically manifest mastoiditis has never occurred as long as the discharge from the middle ear remained serous. But it

is not correct to state that mastoiditis can always be prevented, for in some instances, especially of streptococcus otitis, the discharge is purulent when first seen. At the onset of the disease rest and free action of the bowels are desirable. Some authors recommend cold applications; others insist on heat. In all probability neither application has any influence upon the disease, but heat is often subjectively agreeable. It may be applied in the form of a hot-water bag or the Japanese stove. The latter, a small tin box heated with charcoal cartridges and sold in Chinese stores, is a very pleasant way of making warm applications lasting about two hours. The value of any counterirritants applied to the skin is less than problematic. Subperiosteal abscesses are to be opened by a deep and sufficiently long incision through the bulging area. This may be done even without narcosis or after freezing with ethyl chlorid. This cut, known as Wilde's incision, is all that is required, provided the wound be properly kept open. Wilde's incision is, however, not the proper treatment for a collection of pus due to perforation of the bone. It may answer in a child, but where a narrow long fistula exists, the latter should be enlarged by gouging. Wilde's incision has also been recommended as an abortive measure when the first external signs of mastoiditis appear. On account of the uncertain prognosis of the disease at that time it is difficult to estimate the efficacy of this procedure. If it is done for this purpose, it should be made close to the auricle, so that it can be utilized for a subsequent bone operation if required. In such a case it is absolutely necessary to keep the wound aseptic.

Whenever the pain and tenderness of mastoiditis have lasted without cessation over a week; whenever inflammatory swelling of the soft parts has persisted for more than two days, or when, *under proper treatment*, the discharge of acute purulent otitis has not diminished for about ten days with more or less vague manifestations of mastoiditis, recovery without artificial opening of the

bone cannot be expected. It requires good judgment to guard, on the one hand, against an unnecessary operation, with some, though a small, fatality, and, on the other hand, not to defer surgical interference, which may save the life. When the symptoms of mastoiditis increase steadily for two or three days, or when any urgent signs of cerebral irritation have made their appearance, an operation should be done at once.

**370.** The opening into the mastoid, usually known as Schwartze's chisel operation, is intended to reach the

FIG. 132.—Chisels for opening the mastoid.

antrum by the shortest possible route. It consists in cutting a passage through the bone more or less parallel to the posterior wall of the meatus, and much nearer to the superior than to the inferior wall. Experience has shown that the safest tool is the chisel, of which the wider ones (10 to 12 mm.) are used externally, while in the depth the narrowest ones (3 to 5 mm.) are employed (Fig. 132). The mallet is filled with lead. The hole in the bone is made funnel-shaped, but the wider this funnel is made externally, and hence the shallower its depth, the less the danger of accidental injuries. The hole in

the bone should begin with a width of about 1.5 to 2 cm., but this aperture may be widened if it is necessary to enter very deeply. The external opening should be immediately behind, and its center 2 or 3 mm. below the level of the upper wall of the meatus. The upper border must be below the linea temporalis. The anatomic anomalies to be feared are protrusion of the sigmoid fossa (lateral sinus) toward the antrum or low level of the middle cerebral fossa. The lateral sinus, generally a trifle lower on the right than on the left side, is usually fully 1 cm. behind and slightly above the posterior upper wall of the meatus. The more pneumatic the bone structure, the greater the probability of a normal distance between meatus and sinus; the more compact the bone, the more likely is a dangerous proximity of the sinus to the meatus (see Figs. 87, 89, 104 to 107). In extreme cases there may only be a distance of 5 mm. or even a trifle less separating the two. The exposed sinus, if normal, appears as a bluish-gray vessel, the walls of which can be easily indented by the probe. The danger of wounding the lateral sinus is least if the chisel is only directed downward and (alternatingly) forward after the first few external strokes. The shallowness of the wound is favored by resecting the external portion of the posterior wall of the bony meatus by chiseling in a forward direction. It should be the aim to enter the antrum at its lowest level. As soon as the antrum is exposed, any intervening spongy bony substance can be more safely scooped out with a curet. But if the apex of the conic hole is lower than the center of the meatus, the antrum will generally be missed. In young children the first few strokes of the chisel suffice to break down the thin external wall. In adults 12 to 15 mm. is the average depth of the requisite hole in the bone as measured from the *spina supra meatum*, a short spur at the upper posterior angle of the entrance of the exposed bony meatus, a landmark present in about three-fourths of all subjects. Measured from the external surface of the mastoid bone

itself, the distance is more variable. As soon as this distance is exceeded, the utmost caution is required in order not to wound the facial nerve or the external semicircular canal. When the antrum is not reached at this depth, careful measurements should be made of the depth of the meatus up to the membrana tympani, and if at

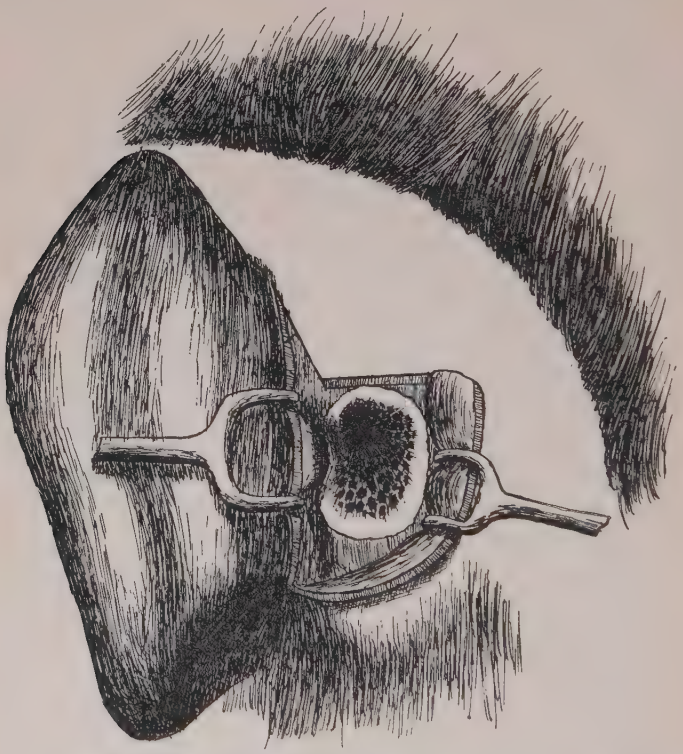


FIG. 133.—Operative exposure of the mastoid antrum in a moderately pneumatic process. Appearance after completed operation and before closure of the wound.

the corresponding distance from the surface of the mastoid the antral cavity is not found, the operation should be abandoned. It is a singular and not yet explained fact that a number of cases with urgent symptoms have done well after such incomplete operations in which the diseased cavity was not reached (Fig. 133).

The bleeding on cutting the soft parts varies with their congestion, as also does the bleeding from the bone. When the antrum is filled with granulations, these bleed very profusely until thoroughly scooped out. When the sinus is accidentally wounded, a big gush of venous hemorrhage occurs, which can be controlled by pressure with gauze. This accident has usually proved harmless in the end, but it may necessitate temporary abandoning of the operation until a firm clot has formed after a few days. Very few deaths have ever occurred from the entrance of air into the opened sinus. Should the cerebral plate be damaged and the dura exposed, no evil consequences result, as a rule, if the operation is done aseptically and all sharp spiculæ of bone are carefully removed. As in all major operations, all details regarding asepsis of instruments, the hands of the surgeon, and of the field of operation should be rigidly carried out. The hair should be shaved far beyond the wound, and the head inclosed in sterile towels or a rubber cap. The instruments required are scalpels, scissors, several forceps, needles, and ligature threads, two retractors, a periosteum elevator, a set of chisels, a hammer, two sizes of sharp curets, and a few artery forceps. The several steps may be summarized as follows:

General anesthesia; incision down to the bone, 1 cm. behind and parallel to the auricle, from its tip to the end of the mastoid process. If this is insufficient, a short posterior transverse cut is made above the middle of the wound. Arrest of bleeding by compression, artery forceps, torsion, and occasionally a ligature. Blunt detachment of the periosteum, both forward and backward. Chiseling of the bone with successively smaller chisels, at first from the entire periphery toward the center of the wound, but subsequently only in the forward and downward direction, and merely upward from the lower edge with care. The chiseling should extend through the posterior wall of the meatus, at least in the external half. If a carious fistula shows the way, this path should be followed by goug-

ing. As soon as the antrum is reached, the granulations usually present are scraped out with the curet, and the bony channel is smoothened with the same tool. The purulent infiltration must be followed as far as it extends. In some instances it is necessary to gouge out the contents of the entire mastoid process through the pneumatic cells to the tip. It is best to remove any overhanging thin cortical shell of bone. The bleeding stops soon after emptying the antrum. In recent cases syringing is uncalled for. When there is retained and foul pus, it is better to irrigate with sterile salt solution. There may be or may not be at the time communication between the antrum and the tympanic cavity, with escape of the fluid through the meatus. Packing of the wound in the bone with iodoform gauze. Suture of the soft parts above and sometimes below the drain. A large gauze pad is put over the wound. Meanwhile the ear has been filled with a fresh sterile gauze drain, whereupon the dressing is completed.

When a carious spot is found leading into some cells below the antrum, and on scooping them out nothing points to involvement of the antrum itself, the operation may be finished at this point, provided the clinical signs did not clearly indicate empyema of the antrum.

**371.** The first dressing may be left as long as five days if neither pain, rise of temperature, nor excessive discharge calls for its removal. The subsequent dressings should also be changed only at the longest intervals proper. The patient is kept in bed for a few days until comfortable. When afebrile from the start, the operation should cause either no rise of temperature or only a transient mild aseptic fever. After a properly done operation the discharge from the ear ceases very speedily. The discharge from the wound rarely disappears in less than two to three weeks, and sometimes as much as six or eight weeks are required, if the wound is not wide enough externally. It is often difficult to keep the wound open, and the gauze drain should not be dispensed with until

the wound is dry. When the discharge remains offensive, which is very rare, it is better to depend on accurate tamponing than on syringing. Attempts have been made to close the wound by a complete suture and to let it heal under a blood-scab. Although this may often be successful in the hands of a thoroughly competent surgeon, it involves considerable risk. It is proper, however, in the case of an incomplete operation in which the antrum is not reached. When the diminished discharge does not require a voluminous dressing, a serviceable form of band-

FIG. 134.—Author's bandage for mastoid operations after the discharge has become less profuse.

age is the one shown in Fig. 134, which is kept from becoming distorted by the insertion of whalebone at its two edges, while the bands of tape prevent it from slipping.

The mortality of mastoid operations is below 8 per cent. in recent years; in some published series of cases even very far below this figure or nearly zero. The majority of deaths are due to the extension of neglected disease, and only a small proportion of the accidents can be ascribed to the operation. The mortality of mastoiditis without operation is not known, but must be very high.

## CHAPTER XLII.

### CHRONIC PURULENT OTITIS MEDIA.

**372.** Chronic suppuration of the middle ear is the sequel of acute inflammation. When the acute symptoms —the pain and the feeling of stuffiness—have subsided, and when the amount of discharge has become about uniform for a number of weeks, the disease can be called chronic and no spontaneous change in the condition can then be expected except in the course of long periods of time. The main symptom is the discharge. This is rarely profuse, generally scant, and sometimes so minimal that it dries in the form of crusts which the patient mistakes for wax. It is always purulent, but when copious, it is apt to be mucopurulent. With rare exceptions the discharge is offensive in smell—characteristically fetid. The rare exceptions are, on the one hand, occasional instances of copious thin mucopurulent fluid; on the other hand, a very scant discharge which dries in the form of minute crusts. The odor of the discharge should always be noted by mopping the meatus with a small pledget of cotton, as its persistence or yielding under treatment indicates the type of the disease and determines the prognosis. When the discharge is so scant that it cannot be seen in the meatus, it should be looked for by mopping with cotton. Even if this test fails, suppurative otitis should not be excluded in suspected cases until the search for small flakes of pus is negative in the water with which the ear has been syringed.

The impairment of the hearing is very variable and depends principally on the destructiveness of the inflammation during the acute period. The deafness may be so slight that the patient is not aware of it. On the other

hand, the ear may be deaf for all practical purposes. The deafness does not depend so much on the perforation of the membrana tympani as on the adhesions in the attic, or between membrana tympani or ossicles and the internal tympanic wall. Noises and stuffiness are rarely mentioned. Dizziness is not common, but when present indicates active disease, usually in the attic (or, in severe instances, caries of the labyrinth).

**373.** Chronic purulent otitis may remain absolutely stationary, or may spontaneously heal temporarily or permanently or may present transient subacute exacerbations.

In the course of time and under favorable environment an otitis which has remained chronic for a long period may finally heal without intervention. But this is not common. The vicious advice so often given by physicians of a former period to let an otorrhea alone was not founded on correct observations. When a chronic purulent otitis has healed, either spontaneously or in consequence of treatment, relapses may be expected under certain conditions. These are mainly the persistence of nasopharyngeal lesions which caused the disease in the first place, especially adenoid vegetations, and less frequently the purulent rhinitis of children. Occasional instances are observed in which a discharge from the ear is started with every severe cold, subsiding afterward even without aid. Independently of nasopharyngeal lesions relapses occur, besides, in a noticeable proportion of patients apparently cured of ear suppuration complicated with cholesteatoma or caries of bone. Whenever a purulent otitis has healed, leaving a permanent perforation of the drumhead, a subsequent attack of purulent infection of that ear begins always in a mild subacute manner and rarely with any intense acute symptoms.

The most serious cases of chronic purulent otitis are those occasionally subject to subacute exacerbations. These are mainly the class which I shall describe as the type of purulent otitis with retention of pus. The

aggravations vary very much in severity and danger. On the whole, however, their danger to life is much greater than that of primary acute inflammations of a hitherto normal ear. The majority of instances of pyemia and of intracerebral complications due to otitis occur in the course of subacute exacerbations of the chronic disease. Various estimates have shown that about ⅓ to ½ per cent. of all deaths are due to ear disease, mainly in the chronic form (in European statistics). These statistics, however, are not absolutely trustworthy. It is worth noting that many life-insurance companies refuse applicants with chronic purulent otitis.

**374.** The liability of an acute suppurative otitis to become chronic depends on the severity of the infection and on the age of the patient. In very young children it is only the severe otitis of scarlet fever or diphtheria which is likely to become chronic, or perhaps a frequently recurrent inflammation due to adenoids. In adults, on the other hand, the healing of an otitis without medical aid occurs only in the mildest forms of inflammation. The direct cause of chronicity is mainly the stagnation of pus with secondary infection from the meatus. In the discharge of the chronic disease the original parasites are not necessarily present. The pneumococcus has, as a rule, disappeared, and has been replaced by streptococci and staphylococci. The fetid odor is due to the coexistence of putrefactive bacilli. The change of an acute otitis into the chronic form indicates inefficient treatment. I am pleased to have noted the gradual diminution in the proportion of chronic purulent otitis presenting itself for treatment in the course of my practice, undoubtedly due to the better training of physicians in otology. It must be admitted, however, that some cases cannot be prevented from becoming chronic, except by opening the mastoid.

**375.** Instead of an unsystematized description of the appearances and lesions in chronic purulent otitis the author prefers to classify the disease under several heads,

with details regarding pathology and treatment subdivided correspondingly.

We can distinguish clinically between—

A. Simple chronic purulent otitis;
B. Purulent otitis with retention of pus—(with or without complications).

In the first type of the disease the suppurating areas are accessible, and the fetor of the discharge is readily removed by cleanliness. In the second type there is retention of pus coming from inaccessible spaces, and the secondary infection which has caused the odor cannot be controlled by syringing. The distinction is based on pathologic grounds, but it can in some instances be recognized only by the therapeutic test. In describing chronic purulent otitis we must furthermore take into account the absence or the presence of complications—viz., polypi, bone disease, and cholesteatoma.

**376.** In *simple uncomplicated chronic suppurative otitis* the perforation of the drumhead seen after cleansing is usually of moderate size, sometimes round, sometimes

FIG. 135.—Large kidney-shaped perforation in membrana tympani in chronic purulent otitis; drumhead thickened, cloudy, and retracted; manubrium only partly visible; tympanic mucous membrane congested.

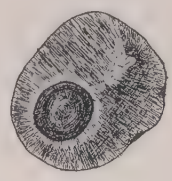


FIG. 136.—Perforation in lower part of membrana tympani in chronic purulent otitis; membrana tympani is thickened and opaque; the mucous membrane of the inner tympanic wall appears dark red through the perforation.

oval, sometimes bean-shaped, and anywhere in the membrana proper (Figs. 135 and 136—compare Figs. 10 and 11, Plate II.). It is not common to see the small, pin-hole-shaped perforations found early during acute suppuration. On the other hand, the total drum-

head and even the ossicles may have been destroyed by the primary disease. Perforations in Shrapnell's membrane usually indicate the type of otitis with retention. The perforation is a stationary condition, not changing in spite of the persistence of suppuration. Through the hole the tympanic mucous membrane is visible, being usually reddened while the discharge lasts.

In default of postmortem information we must assume the lesion in this type of disease to be a superficial inflammation of the tympanic lining membrane. The thickening of the mucous membrane sometimes seen through large perforations can only be due to inflammatory infiltration. No other lesions could disappear as rapidly under treatment.

**377.** Both as a diagnostic test and as a therapeutic measure the ear should be syringed very thoroughly at the first examination. Accidental observations have shown me that syringing alone can cure some instances. The water should be pure and uncontaminated. Sterility, while theoretically desirable, does not seem to be of practical importance. There is no object in adding antiseptics to the water. The time of their action is too short for efficiency. In case of strong fetor it is practical, however, to add some deodorizing substance like permanganate of potassium (1 : 1000) or formalin (1 : 300), in order to prevent the stench from clinging to the basin and utensils. Peroxid of hydrogen, a fluid often recommended, possesses no advantage over any other deodorizer. Its alleged power to dislodge pus by the bubbles of liberated oxygen is a myth. After syringing, boric acid powder is blown in in a thin layer with an insufflator (Fig. 21). The effect of this treatment is complete removal or considerable diminution of the odor within the next twenty-four hours. If two, or, at the most, three repetitions of this treatment at intervals of twenty-four hours do not remove the odor absolutely, the case is not one of simple suppuration without retention, and the further continuance of this

form of treatment is totally useless. In rare cases a single thorough application stops the discharge permanently. More commonly from one to two and a half weeks are required for a complete cure. The discharge gets less copious and thinner gradually. If the treatment ceases while there is slight discharge left, a relapse is very probable. If the intervals between treatments have been too long, the time required for a cure is unnecessarily extended. There should be some powder from the previous application found in the meatus at each dressing. Numerous indorsements of substitutes for boric acid have generally been due to poor observation or poor reasoning. In those instances where there is no retention of pus the healing under boric acid is as rapid as the nature of the lesions permits. Boric acid is said to cause eczema of the meatus in rare instances. This I have never seen. There are some cases, however, in which it starts a profuse watery discharge, and these patients progress more rapidly when nothing is put in the meatus after syringing except a sufficiently large gauze drain. In exceptional instances a tedious mucopurulent but not fetid discharge persists long in spite of treatment—probably coming from the Eustachian tube. The most efficient measure I have found in such cases to be the instillation of tannin dissolved in glycerin (1 : 4).

**378.** After the cure of otitic suppuration the hearing improves, as a rule, but the degree of improvement cannot be predicted. The hearing can be noticeably augmented in some patients and by the so-called artificial ear-drum. This acts simply as a support for the hammer, and is of use only in some instances with moderate-sized or large perforation. A pellet of cotton or a strip of gauze fulfills the same purpose. When the ear has become permanently dry, the Toynbee artificial drum of rubber, mounted on a wire, can be used by the patient on trial (Fig. 138). But, after all, the artificial drum is less often useful than the public believes.

The perforation itself persists after the suppuration

has ceased. An effort may now be made to close the hole, according to the method of Okuneff. The edges of the hole are touched gently with trichloracetic acid, by saturating a thin coating of cotton around a probe with the deliquesced acid. There is usually very slight

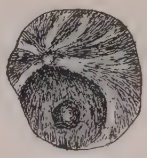


FIG. 137.—Cicatrix in the puckered and thickened membrana tympani after the closure of a perforation due to a severe purulent otitis. The cicatrix appears dark while sunken in; on inflation it becomes more prominent and brighter.

reaction; sometimes, however, a trifling suppuration. After all reaction has ceased, another application may be made if the hole has not closed entirely. The perforation should not be closed if there is any reason to fear relapses.

**379.** *Chronic suppurative otitis with retention of pus*

FIG. 138.—Toynbee's artificial drum membrane, consisting of a round sheet of soft rubber with a wire handle.

FIG. 139.—Perforation in Shrapnell's membrane in chronic suppuration of the attic. The rest of the membrane is slightly cloudy.

may present the same appearances as the simple type of the disease and can then be distinguished only by the failure of the therapeutic test. Generally, however, the appearances are different and indicate involvement of the attic. There are cases in which the membrana proper is intact,

and where there is only a small perforation in Shrapnell's membrane. In others Shrapnell's membrane is largely destroyed and there may even be a fissure or gap in the bone around Rivini's incisure, so that the attic is partly exposed to view (Figs. 139, 140—compare also Figs. 9 and 12, Plate II.). Again, the upper part of the membrane may be intact, but there is a large hole or even total deficiency of the entire lower part, with absence of the handle of the malleus or oblique displacement of its stump (Fig. 141). Less commonly there are two perforations, one of them leading into the attic.

FIG. 140.—Chronic suppuration from the attic with cholesteatoma; destruction of Shrapnell's membrane and of the superior wall of the meatus (anterior wall of the attic), forming a fissure into the attic in which a cholesteatomatous globule is lodged. The membrana tympani proper is nearly normal and only slightly opaque.

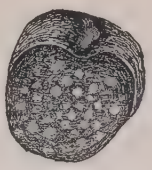


FIG. 141.—Chronic purulent otitis with granulations on the internal tympanic wall. Only a small (upper) rim of the drumhead is still present. The handle of the hammer is partly destroyed, and the remaining stump is adherent to the inner wall of the tympanic cavity.

The criterion, however, is not so much the appearances as the inability to deodorize the discharge. When two, or, at the most, three thorough efforts at syringing, followed by boric acid insufflation, have failed to remove the odor, incomplete drainage of the pus must be assumed, even though the discharge may have been somewhat lessened by the treatment. The continuance of this treatment will then prove useless. In these cases pus is formed in some inaccessible pocket or recess in the attic, and in quite a number of instances there is also suppuration from the mastoid antrum. There may or

may not be complications in the way of caries of the osseous walls or of the ossicles.

**380.** In order to dislodge the pus from its source intratympanic syringing should be attempted by means of a fine cannula introduced into the tympanic cavity. The Hartmann cannula of hard rubber found in the shops is too thick. The author uses a thin metallic tube closed at the end with a lateral eye (Fig. 142). The stream is directed at haphazard toward the attic and toward the mastoid aditus. The tip of the tube follows any preexisting fistulous passage. It requires a steady hand if the tube is attached to a piston syringe, and some pain is inevitable. It may, however, be attached by means of a

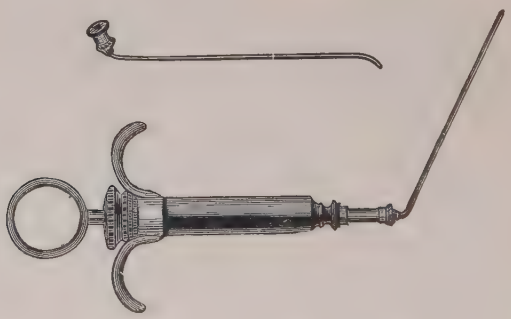


FIG. 142.—Blake's syringe for the middle ear.

flexible tube to a syringe which an assistant manipulates. Sometimes the immediate success of this mode of syringing is assured by the appearance of lumps of inspissated pus of foul odor. Another mode of intratympanic syringing recommended by German surgeons (Schwartze) is through the Eustachian tube by means of the catheter. This is difficult and not always feasible. It is easy, however, in the case of double-sided disease to force salt solution through the Eustachian tubes by means of a Politzer bag filled with the fluid. During swallowing efforts a lively stream of water comes from the ears. I have not found this mode of syringing efficient as often as by means of the intratympanic cannula.

When these measures fail to deodorize, success can sometimes be obtained by filling the ears with a fluid of less surface tension than water. A mixture of alcohol and ether may penetrate into crevices inaccessible to the syringe. It is especially when this alcoholic instillation is followed by an ear bath with carbolated glycerin that an occasional success is obtained in deodorizing the discharge. As soon as the odor has been removed, the case may then be regarded as one of the simple type, without retention, and will, as a rule, heal under the previously described treatment. The healing, however, is apt to require more time.

When all these attempts have failed to remove the fetor, the author can recommend one other measure previous to surgical intervention. This is the drainage of the secretion by capillary absorption through a gauze drain. The meatus is packed with a sterile strip of gauze placed in contact with the drumhead, or even the tympanic lining, and replaced by another before it has become completely soaked by the discharge. This method introduced in the treatment of chronic purulent otitis by N. Pierce proves successful in the end in a number of instances which would otherwise be incurable except by a radical operation. The action of the gauze drain is peculiar. The discharge is often increased slightly at first. It then diminishes gradually without losing its offensive odor until the gauze remains dry. This may take from two to four weeks, or longer if the treatment has not been carried out properly. If a relapse occurs after the odor has once disappeared, the pus is odorless. The various measures may all be combined in the interest of the patient. There is no objection to beginning with gauze drainage at the first treatment. Every effort possible, however, should be made to dislodge pent-up pus from the beginning. For as soon as deodorization of the discharge shows success, precious time has been gained, while if this has failed, the gauze drain has in the meantime begun its influence. Even

after the stagnation of pus has been obviated these cases may prove very slow in healing. But, on the other hand, it is no great hardship to a patient to come once in four or six days for a fresh packing, even though some months be required. When the gauze is left in the meatus for many days it should be kept aseptic by powdering it freely with a mixture of boric and salicylic acids. The longer the time required for the cure of the suppuration, the greater the probability of a relapse at some future time. But even by means of a radical operation we cannot give these patients absolute exemption from relapses, and in the meantime we can at least assure them that they are free from danger as long as the ear stays dry, and practically so if they submit to treatment at once in case of relapse.

**381.** When it proves impossible to remove the odor, or even when the odorless discharge does not yield, which is very exceptional, we must decide whether—(*a*) to desist and wait, (*b*) remove the ossicles, (*c*) open the antrum, or (*d*) perform a radical operation. To desist from further treatment means to keep the patient in constant jeopardy as long as the fetor shows stagnation of pus. If, however, efficient drainage is proven by the absence of odor, the danger of waiting indefinitely while packing the ear aseptically is probably no greater than that of any operation. With aseptic packing such cases will generally heal in the end.

The removal of the ossicles (see ¶ 346) cures those instances in which pus stagnates in the pockets and recesses of the attic, and especially those in which the ossicles themselves are carious (¶ 385). A small perforation in Shrapnell's membrane is strongly suggestive, though not proof positive, of caries of the anvil or hammer or both. A larger destruction of the flaccid membrane, especially if it extends to the periphery, points to caries of the walls of the attic. We cannot foretell, however, in any such case whether the mastoid antrum is involved or not, and hence ossiculectomy,

while usually beneficial, is not always curative. When the pus is abundant we can almost surely expect disease of the antrum. The operation of ossiculectomy is free from serious danger in the hands of the expert. If the stapes is accidentally dislocated, distressing dizziness may follow for many days. Ossiculectomy rarely injures the remaining hearing power, but often improves it to a moderate extent. The operation is usually too painful without general narcosis in purulent cases. In the case of a narrow meatus it cannot be done without temporary resection of the cartilaginous portion. This makes a larger operation, and in such cases it is better to do the radical operation at once.

**382.** Opening the mastoid (¶ 370) cures the majority of cases of otherwise incurable suppuration of the attic and antrum. In these chronic instances, however, the after-treatment is sometimes very tedious and protracted through months. It should be the preferred operation in those instances in which the persistence of good hearing makes it desirable to save the ossicles. It may also be done when the ossicles have been entirely destroyed previously by disease. Simply opening the mastoid is, however, not so sure of success as the radical operation, but, on the other hand, easier and perhaps a trifle safer. After establishing a large opening into the antrum, both this artificial canal and the meatus should be kept packed until all discharge has ceased. This may take from one to four months. In old chronic purulent otitis the mastoid is often found sclerotic, probably as the consequence of long-continued suppuration. It is hence usually more difficult to chisel into the antrum than in the case of fresh disease.

**383.** The **radical operation** is intended to convert the tympanic cavity, the attic, and the mastoid antrum into one large continuous cavity with unobstructed outlet. It should be done in all cases of inaccessible cholesteatoma or of chronic fetid suppuration otherwise incurable, especially, however, when urgent danger symptoms are pres-

ent. Of the various modifications of the radical operation, I will describe the one suggested by Zaufal as the easiest (compare mastoid operation, ¶ 370).

General narcosis. Detachment of the auricle and of the cartilaginous part of the meatus by a long, slightly

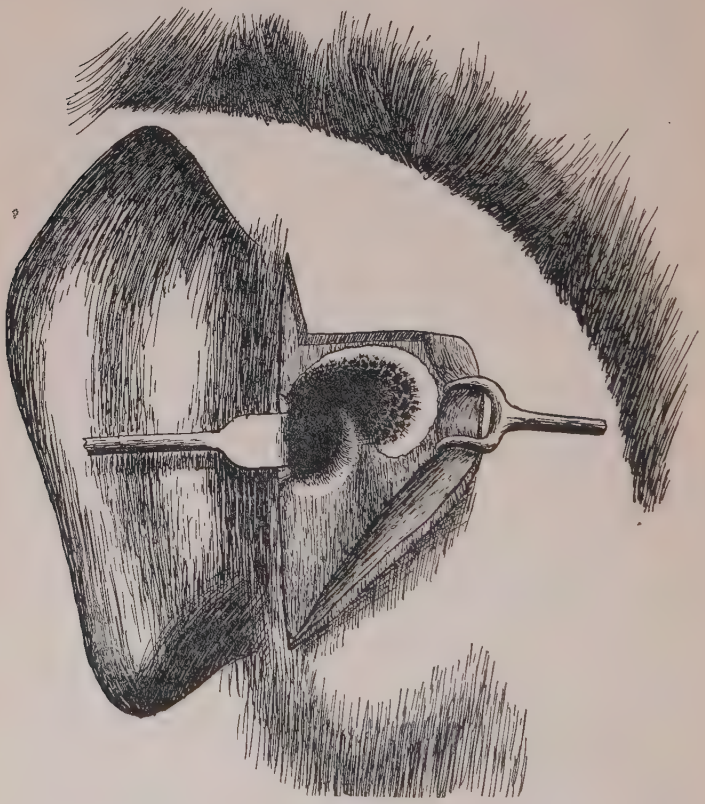


FIG. 143.—The radical operation completed. Antrum and attic fully exposed and the two ossicles removed. Of the internal portion of the posterior wall of the meatus a slanting ridge is left intact in order to protect the canal of the facial nerve.

curved incision down to the bone from above the upper rim of the auricle to a point below the tip of the lobule, 1 cm. behind the insertion of the auricle. Elevation of the periosteum backward and forward from the incision

up to the cartilaginous meatus. Detachment of the latter from the rear, and transverse (vertical) incision with a tenotome through the posterior upper cutaneous wall of the bony meatus as far inward as possible. The partially detached cartilaginous meatus is pulled forward by the steady action of a small retractor placed in the meatus. The mastoid surface is now attacked by the chisel in the usual place—viz., immediately behind the meatus and a trifle above its center. But instead of merely making a funnel-shaped hole in the mastoid process, the chisel is directed against the meatus so that its upper posterior wall is gradually removed. The wound in the bone assumes thus the shape of a broad crater, the inferior and anterior boundaries of which are the normal inferior and anterior walls of the meatus. As soon as the antrum is reached any bleeding granulations are curetted.

While at the external orifice of the wound in the bone the posterior wall of the meatus should be entirely removed, the lower part of the posterior wall must be scrupulously avoided as the surgeon approaches the tympanic cavity (Fig. 143), for otherwise the facial nerve and possibly the external semicircular canal would be wounded. The internal portion of the posterior wall of the meatus hence forms a slanting ridge along the floor of the cavity thus created. After the antrum is reached, small chisels are carefully used to cut away the external wall of the tympanic attic (upper wall of the meatus), so as to gain access to the entire tympanic space, until a curved probe meets with no obstacle in gliding outward from the roof of the attic along the upper (partly resected) wall of the meatus. During this part of the operation Stacke's guard (Fig. 144) may be used to protect the internal wall of the drum cavity (labyrinth and facial nerve) against accidental slipping of the chisel. The guard is held by an assistant after introduction into the drum cavity. The patient's face should be watched continuously by the assistant, in order to call attention

to any twitching of the facial muscles indicative of irritation of the facial nerve. Whenever feasible, delicate bone nippers may be used from the antrum forward to remove the bone in fragments. Finally the entire tympanic space, including its attic, becomes accessible, and on account of the previous removal of the cartilaginous meatus it can be well inspected with good illumination without head mirror. The two ossicles are now removed with forceps after severing their adhesions with small knives. Wherever granulations are found they are curetted off under the guidance of the eye from within outward. Curetting blindly is too dangerous. The stapes should not be touched unless found denuded.

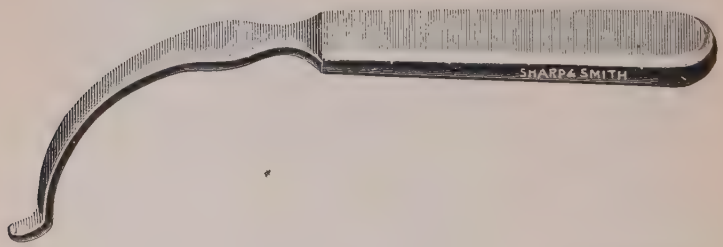



FIG. 144.—Stacke's guard for the protection of the facial canal and labyrinthine wall in the radical operation.

After the removal of all diseased tissue the posterior membranous wall of the meatus is slit longitudinally from without inward, so that the two flaps can apply themselves to the posterior upper bony surface of the surgical channel.

In case of cholesteatoma, or when it has been found impossible to remove all diseased tissue with certainty, or in case of dangerous symptoms, the retro-auricular opening is left open and drained. Otherwise it may be closed by sutures and the after-treatment carried out through the meatus. Very careful packing with gauze is essential. The directions for changing the gauze are the same as in the case of the ordinary mastoid operation. During subsequent dressings any

adhesion of the gauze strips in the depth of the wound can be overcome in the gentlest manner by instilling peroxid of hydrogen solution. The cicatrization of the extensive cavity may be materially hastened by placing Thiersch grafts upon the exposed bone, either at the end of the operation or as soon as satisfactory cicatrization is in progress. Still it never takes less than three to four weeks, and not rarely as many months, before cicatrization is complete and all discharge has ceased. Considerable care is required during the after-treatment. Excessive granulations must be curetted or touched with nitrate of silver. Careful packing is indispensable up to the end. After the discharge has ceased the patient should stay under observation for many weeks with periodic inflations of boric acid.

A properly done radical operation is absolutely curative, but it is not always possible to remove all diseased bone at once. The loss of the odor indicates whether the operation has been thorough or not. Even when some odor persists it will now yield gradually to packing. No radical operation, however, can give an absolute guarantee against a future relapse of suppuration. But with all obstacles to drainage removed, and nothing left but a clear space, such relapses are not likely to prove serious or rebellious to very simple treatment. The radical operation does not often injure what hearing there is left, and, indeed, may improve it moderately. Injury to the facial nerve, a deplorable accident, has happened occasionally in operations done by expert surgeons.

The form of radical operation described above is the one suggested by Zaufal, which I personally consider the easiest and safest for the less experienced operator. Nearly at the same time Kuester, Zaufal, and Stacke (1889 to 1890) advocated a more radical operation than the mere opening of the mastoid in chronic cases, by removing at the same time the posterior wall of the meatus and the external wall of the attic. Stacke's operation is primarily intended for the removal of the ossicles.. The auricle and cartilaginous meatus are detached, and the superior wall of the meatus is chiseled off until no barrier is left in front of the

attic. After cleaning the attic the mastoid cavity is explored through its aditus, and if found diseased is opened by chiseling away the posterior wall of the meatus. Most surgeons, especially in this country, prefer to remove the ossicles through the intact meatus when the anatomic conditions are favorable. Hence Stacke's operation, as mostly done, is really a radical operation with slightly modified technic.

A number of modifications have been devised in the plastic part of the operation, in order to cover the exposed bony surface. Among the most serviceable plans is that of Siebenmann. He does not keep the retro-auricular opening patent as such, but combines its orifice with the meatus by using the skin of the concha as a lining. The detached meatus is slit longitudinally in the center of its posterior wall, and from the external end of this slit a cut is made downward and another upward through the concha, so that the entire incision has the shape of a horizontal Y. The cartilage is thereupon resected from the posterior surface of these flaps, so that they can be completely adapted to the exposed bony surface of the wound, being held in place by tamponing.

As far as the bony surface is surely healthy it may be covered with Thiersch grafts at the time of the operation, which are kept in place by the tampon. In the deeper parts of the wound grafts should be used only after longer observation has shown normal healing without the presence of any bone disease or focus of suppuration.

## CHAPTER XLIII.

### LOCAL COMPLICATIONS OF CHRONIC PURULENT OTITIS.

**POLYPI.—CARIES AND NECROSIS OF THE BONE.—CHOLESTEATOMA.—PARALYSIS OF THE FACIAL NERVE.—TUBERCULAR OTITIS.**

**384. Polypi** are a frequent occurrence in chronic otitic suppuration. Granulation tissue in the form of red, elevated, easily bleeding patches is often seen in the tympanic cavity through perforations. When this occurs in the form of a tumor with a constricted pedicle, it forms a polypus. Polypi are made up of granulation tissue originally, but many in the course of time assume a firmer consistency by fibrillary transformation. They are lined with epithelium and are quite vascular. They may resemble minute beads, being sometimes multiple, or may grow until a large reddish mass fills the whole meatus

FIG. 145.—A lobulated polypus springing from the upper part of the tympanic cavity and protruding through a large perforation in the upper posterior quadrant of the drumhead. The membrana tympani is thickened so that the manubrium is not visible.

(Fig. 145). They originate mostly from the attic; rarely from a carious spot in the wall of the meatus. They are often, but perhaps not always, indicative of caries underneath. When cut off incompletely, they are apt to grow again. Their removal should hence be thorough. Cocain and suprarenal solution make general anesthesia

superfluous. The most satisfactory instrument is a delicate snare (Fig. 146), the loop of which grasps the growth next to its base. The best wire is the thin flexible iron wire used by florists. The base should then be curetted. Cauterization is generally superfluous, except when the base is inaccessible to the curet in the attic. A suitably bent probe upon which a bead of chromic acid has been melted can then follow the path of the polypus to its base. The excess of the acid is removed by a solu-

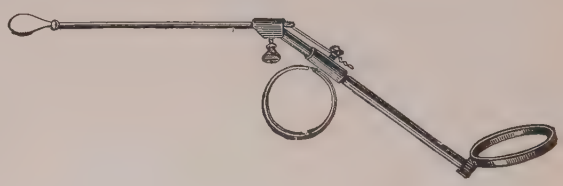


FIG. 146.—Blake's polypus snare.

tion of bicarbonate of sodium. It is worth remembering that small polypi may disappear without operation under boric acid insufflation, provided there is no stagnation of pus.

**385. Bone disease** is a frequent complication and often the cause of the persistence of chronic otitis, especially in poorly nourished subjects. Relatively rare in the simple form, it is very common when there is stagnation of pus. The more usual form of the disease is **caries,** while the **necrotic separation** of a **sequestrum** is much less common. The most frequent seat of caries is in the ossicles, especially the long process of the anvil ; less frequently the head of the anvil or the head of the hammer. The destruction of bone is not a passive corrosion by pus, but a true ostitic ulceration. Caries of the head of the hammer is indicated usually by a fistula in Shrapnell's membrane. Destruction of the anvil may be suspected when the greater part of the membrana tympani is destroyed, or in case of perforation at its upper rear border. Less commonly than in the ossicles caries is found in some area of the tympanic wall ; sometimes even in the

meatus. A noticeable seat of the disease is the bony margin around Shrapnell's membrane, where large bony defects are not infrequently met with. There are no symptoms attributable to caries in these localities beyond the persistence of the discharge. Whether the fetor of the discharge can be abolished or not depends on the conditions for drainage and not on the presence of the bone disease. The diagnosis can be assured only by feeling the exposed bone with a delicate probe. Granulation tissue and polypi render the existence of caries underneath probable.

The treatment in these instances is that of the chronic otitis. After drainage has been established as indicated by the absence of fetor, carious spots will generally heal. When an odorless slight discharge proves rebellious to treatment, various devices may be used with more or less uncertain result. Instillations of a 4 per cent. solution of hydrochloric acid left in for some fifteen minutes or kept in for a day on a pledget of cotton, can dissolve dead bone and facilitate cicatrization, but the effect is uncertain. A solution of iodoform in alcohol and ether has proved a little more definite in its action. A few times I have seen unquestionable results from the use of balsam of Peru, followed by the ordinary aseptic packing.

Caries in the mastoid antrum is incurable as far as we know, except by proper opening of the antrum. In the antrum necrotic sequestra are found oftener than in other parts of the ear.

When progressive caries extends inward into the petrous bone, it may lead to serious symptoms. Carious spots have been found relatively often in the bony walls of the semicircular canals, especially the horizontal canal. This localization is characteristically indicated by persistent dizziness. Headache and local pain may or may not be present. When present, however, these sensory symptoms constitute an important warning. A small number of instances have been observed in which necrosis extended into the petrous pyramid and the entire cochlea

has been extruded by spontaneous demarcation a number of times with ultimate recovery. Whenever urgent symptoms—dizziness, pain, headache, especially with fetor of the discharge—indicate progressive caries, nothing can be considered except a radical operation. In all instances of caries the general health should receive due attention, and no details of hygienic management—fresh air, exercise—or therapeutic indications—iron, cod-liver oil, or whatever may be required—should be overlooked.

**386. Cholesteatoma** is the most serious of all local complications of chronic otitis. This name is given to concretions of exfoliated epidermis gathering in the aural spaces during or after a chronic suppurative process. The desquamative inflammation limited to the meatus has been described under the head of epidermis plugs (¶ 325). Oftener than in the meatus it is found in the attic of the middle ear and in the mastoid antrum. The masses are white or yellowish, distinctly laminated, sometimes of firm consistency, and rounded like a pearl; at other times more friable and conform with the shape of the space. The masses consist of epidermis scales with cholesterin crystals and more or less inspissated pus. When there is suppuration, there is always decomposition of fluids around and in the cholesteatoma. But after the suppuration has ceased there may be no fetor whatsoever. Even bland, odorless cholesteatomata may continue to grow and enlarge the bony space in which they are confined. The formation of these masses is due to desquamation of cutaneous epithelium derived from the meatus, which has grown through a peripheral perforation in the drumhead into the middle ear or attic, or even into the mastoid antrum. This comprehensive statement defines the conditions under which cholesteatomatous concretions grow. Why this desquamation takes place is not fully known. It may continue to take place even after suppuration has ceased.

The diagnosis of cholesteatoma is obvious when the mass is seen either limited to the meatus, or protruding

into the same, or when visible in the attic on account of the existence of a defect in the bone at the upper margin of the drumhead. (Comp. Fig. 12, Plate II.) When the cholesteatoma is not visible, its presence may be inferred by the persistent appearance of epidermis scales in the fluid on irrigating the middle ear. Inspection must decide, however, whether these scales are not simply derived from the macerated walls of the meatus. Cholesteatoma confined to the antrum may not make its presence known until the cavity is opened by an operation.

When a cholesteatomatous formation coexists with fetid suppuration, the latter cannot be influenced until the epidermis masses are removed. This is possible only if they are accessible to the eye or to the intratympanic cannula, but not if they extend into the antrum. When the otitic suppuration has been cured, the masses may form again in the course of months without producing symptoms. Sooner or later relapse of suppuration will follow. As a rule, this can again be cured by the complete removal of the cholesteatoma. In those instances in which past experience has shown that the suppuration can be easily deodorized and controlled the patient is in no greater danger when treated conservatively and watched than when subjected to the radical operation, especially as the latter, too, gives no absolute guarantee against relapse. If, however, the discharge cannot be deodorized, a cholesteatoma demands radical operation without question. There are obscure cases in which cholesteatoma of the mastoid antrum without suppuration causes persistent dull feeling, discomfort, pain, and threatens life by the possibility of pyogenic complication with extension. A presumptive diagnosis of such cases is based on the history of former long-continued suppuration and the existence of peripheral defects in the drumhead.

**387.** Since the facial nerve is separated from the tympanic cavity only by the thin walls of the Fallopian canal, which may even be defective, it is evident that

**facial paralysis** may occur in consequence of middle-ear disease. This is rare in the course of an acute catarrhal otitis, and not common in acute suppurative inflammation, but by no means rare when persisting suppuration has led to caries. Facial paralysis is more often due, however, to traumatism, rarely from the simple mastoid operation, oftener from a radical operation even by an experienced surgeon. It may likewise result from violence in the extraction of a foreign body. The symptoms are the well-known palsy of the facial muscles on the same side. In the case of a paralysis due to an inflammatory process recovery may follow in three to six weeks. Severe traumatism may protract the regeneration until after the lapse of four months or may make it impossible. It is an open question among neurologists whether the local use of electricity in any form has a permanent influence. When the paralysis is due to an inflammatory process, improved drainage, if necessary by means of a mastoid operation, is indicated. In all operations involving the posterior wall of the meatus the part adjoining the drumhead should be scrupulously avoided on account of its proximity to the Fallopian canal. The latter is not endangered by the removal of the upper wall of the meatus. The chorda tympani nerve is easily wounded by intratympanic manipulations; necessarily so during removal of the ossicles. Its division causes loss of taste in the tip of the tongue with a numb feeling.

**388. Tuberculosis** of the middle ear is not a frequent disease, but common enough to deserve attention. It is probably always secondary and usually occurs only in pronouncedly tubercular subjects. The process may begin in the tympanic mucous membrane, but is almost sure to invade the bone sooner or later. Tubercular otitis is characterized by the absence of acute symptoms, even if of acute onset. Pain is conspicuously absent. There may be a feeling of fulness for a few days, whereupon perforation occurs and a seropurulent discharge

begins. In some instances tuberculosis of the middle ear leads to abundant granulations filling the entire cavity. In others a fibrinous pseudomembrane adheres to the diseased surface. In either case there is remarkably little irritation. In advanced tuberculosis of the system the drumhead and bony walls may break down very rapidly with scarcely any granulation tissue. The diagnosis suggested by the tubercular history and the peculiar onset should be verified by searching for the tubercle bacillus in the discharge by means of the usual staining methods. The bacilli are sometimes scant in number, and may be found only after repeated examination.

Under favorable environment and proper local treatment the disease may come to a stand-still or even end in recovery. The local treatment is the same as in other forms of otitic suppuration. When destruction of bone has occurred, a radical operation should be performed if the general health warrants it. In properly selected cases it arrests the local disease permanently. Of course, all hygienic measures proper in tuberculosis should be carried out.

## CHAPTER XLIV.

### OTALGIA.

**389.** The name otalgia is given to the various forms of pain referred to the ear which cannot be traced directly to some aural lesion. It is hence the generic name of pain which may vary much in character and duration. The complaint may be a trivial one; or, in other cases, it may incapacitate the sufferer. It is mostly one-sided.

Some instances of otalgia can be definitely traced to a dental origin—sometimes the eruption of a wisdom-tooth, oftener caries of a molar tooth, either upper or lower. In the former case the pain ceases when the tooth has made its appearance, unless some soreness of the gum persists. In the case of a carious tooth the pain may persist until the origin is recognized and remedied. There may not be any toothache whatsoever. Sometimes the pain is intermittent. In an extreme instance observed by myself a young child had had daily attacks of earache for some months. After passing through the hands of half a dozen physicians without relief, the child had become accustomed to daily injections of morphin. The attacks ceased at once after extracting a carious tooth.

In other instances the pain referred to the ear is of pharyngeal origin. Acute inflammations in the lateral angle of the pharynx, ulcerations of any kind, tonsillar wounds, carcinoma of the faucial or lingual tonsil, are all apt to be accompanied by more or less earache. But when such lesions can be demonstrated, the term otalgia is superfluous. In hysteric subjects painful affections of the throat sometimes leave behind a psychic remembrance of the pain referred to the ear, even long after the heal-

ing of the original lesion. It is very difficult to relieve such patients. Their pain usually yields to nothing but time, or some strongly impressive suggestive treatment. The use of electricity may come under this head. Severe pain, constant or intermittent, referred to the mastoid region without evidence of existing ear disease, is in rare cases due to a growing cholesteatoma without suppuration, or may even indicate a subdural abscess. The diagnosis is suggested in such cases by the former history of otitic suppuration. There are on record some instances in which persistent pain, uncontrollable by other means, led to an attempt at mastoid operation. The bone was found sclerotic. The antrum was either not reached or found intact, and still the operation, apparently uncalled for, resulted in a permanent cure.

In the majority of cases of so-called otalgia no local cause can be found. Sometimes the attacks are typically neuralgic and may yield to antipyrin, quinin, or arsenic. Regular periodicity of the pain has in a few instances been traced to malarial influence and cured by quinin. In other cases again the pain is not typical of neuralgia. It may depend on anemia, and in such instances is benefited by iron. If it is in any way related to rheumatism, large doses of salicylate of sodium may sometimes prove of benefit. One of the rarest forms of otalgia, usually bilateral, is periodic migraine localized in and limited to the region of the ear. Its diagnosis is made by its irregular periodicity and its accompanying symptoms—for instance, the more characteristic sick headache or nausea.

## CHAPTER XLV.

### PYOGENIC EXTENSION OF OTITIS.

**SEROUS AND PURULENT MENINGITIS.—PHLEBITIS AND THROMBOSIS OF THE LATERAL SINUS WITH SEPTICEMIA OR PYEMIA.—SUBDURAL ABSCESS.—ABSCESS OF THE BRAIN.**

**390.** The greatest danger of otitic suppuration, acute or chronic, is the possibility of its extension into the cranial cavity. This may take place through the intact roof of the middle ear or of the mastoid antrum, when the plate of bone is thin or even partially deficient. In children the relatively thick roof of the mastoid antrum diminishes the danger from this locality. Oftener, however, carious spots and fistulæ are found in the roof of tympanum or antrum. In the antrum the inflammatory process may extend through connecting pneumatic cells to the cranial surface. Less common is suppurative extension into the labyrinth, whence it can reach the cranial cavity either through the aqueducts or along the course of the auditory nerve. Quite rare is the propagation of the disease through a thin anterior wall of the tympanic cavity to the carotid canal and thence upward.

The diagnosis of intracranial complications may be quite difficult, especially the differential diagnosis between the different lesions. With the exception of meningitis the other complications may sometimes develop so gradually as to mislead any one not thoroughly familiar with the symptomatology of inflammatory ear disease. On the other hand, an otitis may itself provoke symptoms which suggest a cerebral complication. As pointed out in ¶ 358, acute otitis produces occasionally in children—very rarely in adults—symptoms which simulate brain disease—viz., headache, stupor, delirium,

or convulsions. The dependence of these symptoms on the inflammation of the middle ear may be shown by their prompt cessation after paracentesis of the drum-head, but such observations are very rare. The persistence of such symptoms, except headache, after free drainage has been established would positively indicate extension beyond the tympanic cavity.

In chronic cases with cholesteatoma or caries it may also be difficult to recognize intracranial complications at the beginning. One-sided headache, dizziness, nausea, and vomiting may depend merely on extension of the disease into the labyrinth, or may signal the beginning of an intracranial accident. Fever is a more significant symptom. It is only moderate and transient in uncomplicated acute otitis, except in children. If, therefore, a high fever persists during acute aural disease, or still more significantly, if fever develops in the course of a chronic otitis, it means either meningitis or thrombosis of the lateral sinus. In the former case the fever is more continuous, and chills are not common, while sinus disease is characterized by sharp thermometric fluctuations, often with chills. Yet this rule is not absolute. Abscess, either subdural or intracranial, has but little, if any, fever. When distinctly cerebral symptoms occur,—viz., mental alterations, coma, delirium, pareses (more than merely facial),—intracerebral disease is evident, but even then a differential diagnosis may be difficult. Inflammation of the optic nerve (optic neuritis or choked disc) is rather exceptional in all these affections, but when present, is very significant. All cerebral complications are apt to produce the systemic disturbance common to pyogenic infection—viz., derangement of the appetite and digestion, furred tongue, constipation, and lack of vigor.

An important diagnostic method in obscure cases is lumbar puncture—the tapping of the spinal canal below the spinal cord. As the question has lately been raised regarding the absolute safety of this procedure, it is best

to limit its use to those instances in which no diagnosis can be made without it. The technical details of this operation do not require discussion in this place. The information gained by lumbar puncture is positive as to the existence of meningitis, negative regarding the other complications. When the cerebrospinal fluid escapes under abnormal high pressure, but is either perfectly clear or contains only microscopically leukocytes, a serous meningitis is proved. When the fluid, however, is turbid and the microscope reveals the presence of pus-cells as well as bacteria, especially streptococci, it is proof positive of a purulent meningitis. In abscesses within the skull and in sinus phlebitis the evidence by lumbar puncture is negative.

The otitic intracranial complications are most common in late childhood and early middle life, are decidedly more frequent in the male than in the female, and occur oftener on the right than on the left side. Of all the lesions, the extradural abscess is the most frequent and often the intermediate step between ear disease and the other complications. In the case of acute otitis the cerebral sequels may not become manifest until quite a time—even weeks—has elapsed after the apparent cure of the ear disease. The liability to cerebral complications is very small in those cases of chronic purulent otitis in which free drainage is indicated by an absence of fetor. The greatest danger is in the cases with stagnation of fetid pus, especially in the course of subacute exacerbations, particularly when caries or cholesteatoma exist.

It is sometimes not possible to recognize with certainty the existence of an intracerebral complication or to diagnose the exact lesion prior to the operative dissection. If in the course of an operation carious fistulæ or paths of granulations are found, they are to be followed up to wherever they lead. As with rare exceptions these patients are sure to die if not treated surgically, the operation must not stop short of the utmost obtainable

limit. To refuse an operation means sure death. In every case the suppurative focus in the temporal bone should be completely eliminated. This, indeed, may be sufficient for recovery from beginning sinus thrombosis, serous meningitis, possibly even circumscribed purulent meningitis. It is prudent for the aurist of limited experience to employ trained surgical assistance.

The importance of the subject demands a detailed discussion of each lesion, while on account of the rarity of these complications this will be made very brief.

**391. Extradural** or **subdural abscess** occurs between the bone and the external layer of dura mater, which serves as periosteum. It begins always on the temporal bone, rather oftener in the posterior than in the middle cerebral fossa. Exceptionally it may be situated deeply near the apex of the petrous pyramid. Its size varies from that of a small to a large nut. In the cases due to acute otitis the dura is usually covered with granulations, and the pus is odorless, containing the pneumococcus perhaps oftener than any other microbe. In chronic cases there is apt to be sloughing of the membranes, and the pus is often fetid. If let alone, the abscess will in rare instances break through the tympanic roof, or even through the squamous plate of the temporal bone. As a rule, however, it proves fatal by leading to meningitis or to sinus thrombosis with pyemia after the lapse of weeks or months.

The diagnosis of extradural abscess is very obscure. There may be scarcely any distinctive symptoms. Headache, especially when localized, tenderness, sometimes indicated by rigidity of the neck, are its most frequent manifestations. As a rule, there is no fever at all; sometimes a slightly abnormal evening temperature. But slight systemic and stomach disturbance, and especially constipation, is often noted. Vertigo, nystagmus, nausea, and vomiting may be present, but are perhaps of otitic origin. Distinctive cerebral symptoms are exceptional and rather suggestive of other complications. The

most positive but infrequent evidence is circumscribed tenderness with edema or even a subperiosteal abscess behind and above the ear, due to pyogenic penetration along a venous channel in the skull. In many instances the diagnosis can be made only by finding and following carious tracks or cellular paths filled with granulations during a mastoid operation demanded by the aural condition.

If such carious or granulation paths are seen, they will be found to lead to the abscess on persisting in the judicious use of chisel and rongeur forceps until the dura is exposed over a sufficiently large area. The dura should not be opened or curetted even if covered with granulations, in order not to excite a meningitis. If symptoms suggesting a subdural abscess persist after a properly performed mastoid or radical operation in which the cranial cavity was not opened, a secondary operation should be made. If no local indications are found along which the opening should be extended, the skull may be trephined through the squamous portion. The extradural exploration should be followed up, if necessary, to the apex of the petrous pyramid. A simple after-treatment is carried out along the usual lines of modern surgery with an iodoform gauze drain. The mortality in early operations of uncomplicated subdural abscess is very small, but increases materially when other complications have occurred.

**392.** The **intracerebral abscess,** more common in chronic than in acute cases, is sometimes, but not as a rule, secondary to a subdural abscess. The exciting microbes may spread along the course of small arteries, veins, cerebral nerves, or strands of connective tissue. It is always on the same side of the ear, more often in the temporal lobe of the cerebrum than in the cerebellum, rare in the basal parts or in the occipital lobe. The otitic abscess is single. If multiple, it may be of pyemic origin.

R. Müller has lately tried to distinguish between inter-

stitial and parenchymatous brain abscess. In the former case the pyogenic microbes, usually streptococci, travel along a connective-tissue septum and produce a true abscess with an abscess wall. These pus accumulations are likely to cause pressure symptoms. The parenchymatous abscess, on the other hand, is due to the invasion of the brain substance by destructive bacteria. It is often due to a mixed infection and contains fetid pus, with sloughing of the brain substance, but with little inflammation. It is more apt to cause symptoms resulting from destruction than those due to pressure. Müller admits, however, that the majority of abscesses are of a mixed type.

The beginning of brain abscess may or may not be indicated by vague symptoms, general disturbance, headache, nausea, vomiting, and perhaps slight fever. As a rule, the abscess then follows a latent course for weeks or months. When its presence finally becomes manifest, we can distinguish between diffuse and focal symptoms. The former are general malaise, sometimes constipation, headache, more or less severe and not necessarily localized, tenderness of the scalp, slowness of the pulse, dizziness, mental alterations, insomnia, delirium, and coma. These symptoms are present to a very variable extent. Optic neuritis is not common, but if present is significant. The focal symptoms are of greater importance for diagnosis, but may be late or even absent. Abscess of the temporal lobe may cause deafness of the other ear, word-deafness, disturbance of speech and some form of aphasia, especially if left-sided in a right-handed subject, or vice versâ. If it extends toward the internal capsule, it may cause hemi-anesthesia or hemianopsia and crossed paralysis of the facial nerve and arm or leg; rarely, spasms. In the cerebellum the abscess is likely to reveal itself by localized occipital headache, rigidity of the neck, ataxia, staggering, vertigo, and vomiting. An abscess in any locality may raise the intracranial tension sufficiently to cause palsy of the various ocular muscles.

In the diagnosis of brain abscess special care must be taken to distinguish it from brain tumor and tubercular meningitis.

Without treatment abscess of the brain is invariably fatal, mostly by breaking into the ventricle and causing meningitis. By operation, however, over 50 per cent. of cases are permanently cured. The abscess may be searched for from the extension of the wound made in a mastoid or radical operation, if the latter is indicated. Otherwise it is preferable to open the skull with a trephine or by means of an osteoplastic resection above the auricle.

A crucial incision is made into the dura. Sometimes the brain substance will protrude if the abscess is in the proximity. No definite conclusion can be drawn from the presence or absence of brain pulsation. It is more certain, and not any more dangerous, to explore the brain with a knife thrust in the suspected direction than with a needle. Four centimeters is the limit of safety, for beyond this distance the ventricle might be tapped. When the pus is found, the intracerebral incision is dilated by means of forceps and a large gauze drain is put in. The after-treatment is according to ordinary surgical principles.

**393. Meningitis** is, of all complications, the one most feared. Purulent meningitis was until lately considered fatal and a positive contraindication to operations on the skull. Yet a few recoveries have lately been recorded after radical operations. The gloomy prognosis when the diagnosis meningitis is first made is, moreover, somewhat relieved by the possibility that instead of a purulent process it may be the so-called serous meningitis, which ends in the recovery after elimination of the suppurating focus. A serous meningitis cannot be distinguished at first from the purulent inflammation of the membranes, but, unlike the latter, it tends to recovery after a radical operation. In serous meningitis the brain membranes as well as the brain substance appear edematous when ex-

posed, and upon incision a copious flow of clear fluid ensues. This discharge may last several days. In purulent meningitis the purulent inflammation of the arachnoid space is at first limited to the region of the disease in the temporal bone. It may remain thus localized by reason of adhesions, and perhaps occasionally heal. But usually it spreads and reaches other distant areas of the cerebral surface. Sometimes a meningitis of a very acute character is due to the perforation of an abscess into the ventricle.

As a rule, meningitis begins with fever, which is apt to be continuous and high. Rarely is fever absent—most likely perhaps in localized meningitis or in the serous variety. Diffuse severe headache is a prominent symptom, with rigidity and often forcible backward retraction of the neck. The head is very tender on motion. Dizziness and vomiting are common. Soon other cerebral symptoms follow, such as various pareses of eye muscles, eyelids, or muscles of the extremities. None of the eye symptoms are absolutely diagnostic either way. The often mentioned boat-shaped retraction of the abdominal muscles is also not constant. The mind may stay clear, but, as a rule, becomes obscured several days before death. Somnolence or delirium may occur. When the meningitis extends down the spinal cord, the accompanying pain indicates this involvement, and corresponding pareses of the limbs, as well as of the sphincter muscles, may ensue.

A serous meningitis which simulates purulent inflammation may disappear within a few days or a week after thorough removal of all diseased bone and the opening of any abscess. Purulent meningitis, when well pronounced, is probably always fatal within a period of a few days to three weeks at the latest, usually inside of the first week. No treatment can be advised directly against the purulent form of the disease. Indeed, until recently most surgeons abstained from any operation when the diagnosis of purulent meningitis was made.

**394.** Next to extradural abscess **phlebitis** with **thrombosis of the lateral sinus** is the most frequent consequence of ear disease, especially in chronic cases. It is often, but not always, the result of an extradural abscess around the sinus—the so-called perisinuous abscess. In other instances no distinct abscess is found but merely continuity of pyogenic infection through the walls of the antrum, as indicated by caries or granulation tissue. The inflammatory process may lead to circumscribed phlebitis and thickening of the sinus walls, without thrombosis. On the other hand, a thrombosis may begin without much visible change in the appearance of the venous wall. The thrombus is at first small and parietal—*i. e.*, adherent to the wall, without complete obstruction of the venous channel. It may or may not finally occlude the caliber. The thrombus may or may not remain firm and bland, the bland thrombus being probably due to the action of absorbed toxins, without invasion of the clot by living bacteria. But if not interfered with surgically, the thrombus is sure to become septic at last. On opening the sinus it will then be found filled with pus or chocolate-colored decomposed blood. Occasionally the wall remains apparently sound, merely thickened. Often, however, in septic cases the venous wall is discolored grayish or greenish and becomes perforated or even gangrenous. The thrombus may extend backward to the torcular and centrally to the jugular bulb, or even far into the internal jugular vein. From the jugular bulb retrograde thrombosis may enter the petrosal and even the cavernous sinus.

Systemic infection is sure to follow if the changes in the sinus are not arrested by operation at an early period, for even in the case of a clot solid at both ends liquefaction and entrance of microbes into the circulation will ultimately take place. The absorption of toxins reveals itself by fever and general systemic disturbances, while the detachment of particles of the clot laden with bacteria

causes pyemic metastases, especially in the joints and lungs; less often in other viscera.

**395.** At the beginning the symptoms of sinus thrombosis are not very distinct. They are merely the exaggeration of the disturbances produced by a severe mastoid process. Headache is rarely absent, and especially prominent when the thrombosis is started by a subdural abscess. Malaise and gastric disturbances may be due to the mastoid disease alone. The characteristic symptom, however, is fever. Whenever the fever of an acute otitis does not cease within a few days, except in children; whenever it increases suddenly or steadily; and especially when fever sets in in chronic afebrile cases, sinus thrombosis should be at once suspected. Chills alternating with extensive fluctuations in temperature establish the diagnosis; yet there are occasionally rare exceptions to this rule. Tenderness, edema, or inflammatory swelling over the site of the sinus are not constant, but very suggestive symptoms.

If the thrombosis extends into the jugular vein, this is often indicated by perceptible hardness and tenderness of the vein, sometimes with inflammatory edema of the tissues of the neck. This condition must not be confused with perforation of a mastoid abscess through the internal surface of the tip.

The absorption of septic poisons is indicated only by the general systemic disturbances, including enlargement of the spleen and sometimes jaundice. Pyemic metastases, however, produce unmistakable symptoms. If they occur in the joints, the latter become tender and swollen. In the lungs the pyemic emboli are revealed by the occurrence of sudden irritation and cough, and if superficial enough, they can be detected by dulness and râles. The clinical picture may be complicated by the coexistence of a serous meningitis with the symptoms peculiar to it.

With rare exceptions sinus thrombosis is fatal unless treated surgically. The earlier the operation, the greater

the chances of recovery. Even in unselected cases the mortality is not over 50 per cent., and very much smaller when all unnecessary delay is avoided. If only metastases into the joint have occurred, the prognosis is still fair; more serious, however, in the case of pulmonary embolism. In any case operation should be attempted.

**396.** According to the existing indications, the operation should either be the simple chiseling into the mastoid or the radical clearing of mastoid antrum and tympanic attic. The sinus is then to be laid bare by working upward and backward from the antrum, using small rongeur forceps as much as possible in preference to the chisel. When the indications are clear for incision into the sinus, the latter should be exposed to the utmost extent—3 to 4 cm. or even a trifle more. Whether the operation should include opening of the sinus or not must be judged by the following criteria: If the symptoms are relatively mild and the sinus wall is not discolored, and the sinus is still felt by the probe to be a channel containing fluid blood, it may be let alone after completely removing all diseased bone and exposing the sinus wall. The incision into the sinus may not add to the danger of the operation, but, on account of hemorrhage, it complicates the after-management. If the septicemic symptoms do not abate in the course of one to two days, the sinus may be opened at the next dressing without the necessity of narcosis. But in the case of pronounced pyemic symptoms or even in the absence of the latter when the sinus is discolored or gangrenous it should be included in the operation. Even when the venous wall shows little change, it may be found that the severe systemic symptoms present are due to the septic breaking down of the clot. The puncture of the sinus by means of a hollow needle is not a reliable diagnostic method, as it neither reveals a small parietal clot nor any small accumulation of pus which it does not happen to strike, while it does involve the danger of infection of the dura if the needle happens to perforate the

inner sinus wall. The opening of a sinus begun with scissors may be finished with a bistoury on the grooved director. The broken-down clot should be scooped out until a solid thrombus is reached, and toward the rear even until the blood begins to flow. It is best to excise the infected part of the sinus wall. Before the sinus is opened the operation on the bone or on any existing subdural abscess should be completed, because hemorrhage may enforce a rapid interruption of further operation. It can, however, be always checked by compression with gauze.

Opinions are divided as to the advisability of ligating the jugular vein. Its exposure adds to the shock of an otherwise necessarily long operation (one to two hours). It is also said that ligation of the vein is neither an absolute preventive of pyemia nor necessary in every instance of jugular thrombosis. Yet experience has shown that the danger of pyemia is certainly diminished by eliminating a menacing clot in the jugular vein. When jugular phlebitis can be recognized, it is best to begin the operation by an extensive exposure of that vein in the neck. It should then be ligated below in the apparently healthy part, and upward as close as possible to the jugular bulb, and the intervening portion excised, with ligation of the internal facial vein. If the exposure of the lateral and sigmoid sinus shows thrombosis extending to the jugular bulb, many good operators deem it best to ligate the jugular vein in the neck before proceeding to clear out the sinus.

## CHAPTER XLVI.

### DISEASES OF THE INTERNAL EAR.

**397.** The labyrinth is found diseased in about 5 to 8 per cent. of ear patients. The differential diagnosis between lesions of the labyrinth and those of the middle ear can usually be made with certainty, but it is often impossible to distinguish between affections of the internal ear and those of the auditory nerve, except by the history and other concomitant symptoms. Since the labyrinth is the organ of both the sense of hearing and of the static sense, its disease may cause symptoms referable to either or both. On account of their vehemence the disturbances of the static sense are apt to predominate in the clinical scene. Dizziness may vary from a mere sense of unsteadiness to a feeling of passive rotation or falling. It is relieved by rest in bed, but may even then be distressing. When severe, the dizziness is apt to lead to nausea and to vomiting. It may also reveal itself by nystagmus-like swinging movements of the eyes, generally of slow rhythm. Vertigo necessarily interferes with steady gait. There may be incoordination of movements. In pronounced instances the sufferer steadies his walk by spreading the legs. The dizziness is apt to last as long as the lesion in the semicircular canals is of an irritative character. When it begins to decline, it is apt to fluctuate in severity with periodic intensification. In most instances the dizziness ceases ultimately. The patient learns to control his movements with the correlated aid of the other senses, so that finally he gets along fairly well under ordinary circumstances. But when the eyes are closed, the unsteadiness reappears. After extensive disease of the semicircular canals all unusual movements requiring

fine coordination—for instance, standing on one leg or balancing—become difficult or impossible.

**398.** The hearing may be but moderately damaged, or it may be entirely abolished. Absolute deafness is a positive proof of labyrinthine disease, except when due to destruction of the auditory nerve. It is characteristic of labyrinthine lesions that the perception of high tones is lost first. The failure to hear the highest notes of the Galton whistle proves disease of the internal ear. If the deafness is not absolute, it may be often found that there are small "islands" in the auditory range for which perception is still retained, with a defect for the greater part of the scale. Tuning-fork tests show that bone-conduction is reduced to the same extent as air-conduction. The Rinné test is always positive, never negative. The time of perception of the tuning-fork placed on the skull is reduced in proportion to the deafness. In Weber's test the sound of the tuning-fork is referred to the better ear if the affection is not symmetric. When labyrinthine disease is complicated by middle-ear lesions, all tuning-fork tests become indecisive. In such cases dependence must be placed mainly on the loss of the high tones and on the history.

Another symptom of cochlear involvement is diplacusis. A musically trained ear hears certain or even all tones accompanied by another note one-half to one tone higher or lower in pitch. As a rule, diplacusis is due to hearing the "false" note in the affected ear, with normal perception in the other, but it may also be due to "double" hearing in the diseased ear. Still diplacusis is very rare in purely labyrinthine affections. This symptom, infrequent at best, is oftener met with in slight exudative catarrh of the middle ear, denoting, nevertheless, a labyrinthine complication, usually of a very transient character. Tinnitus is complained of in all affections of the internal ear, except when the auditory nerve-ends are totally destroyed. There is nothing about the noises which distinguishes them from those heard in

diseases of the middle ear. They are apt to vary in intensity with the nervous condition of the patient.

Affections of the labyrinth are either complications in the course of middle-ear disease or due to descending processes from the cranial cavity, or, in a minority of cases, strictly primary. Even of the primary labyrinthine lesions many are the result of some previous systemic disease. As the most striking type of an affection of the internal ear it is best to begin with the description of—

### LABYRINTHINE APOPLEXY, OR MÉNIÈRE'S DISEASE.

**399.** Intralabyrinthine apoplexy begins in the form of a sudden spell. The patient is seized by intense dizziness and falls, usually remaining conscious, but in some instances becoming even unconscious for a short time. Nausea and vomiting soon follow. When the sufferer regains his self-control, he notices intense noises, sometimes hissing, sometimes roaring or rumbling sounds, and discovers that he is partially or totally deaf, at least in one ear, sometimes in both. The spell usually begins without warning. Occasionally it is preceded by hours of prodromal symptoms of similar nature as the spell itself, though much less severe. At the beginning of the attack headache is sometimes present. The dizziness is apt to enforce rest in bed for days, or even longer. The attempt at walking results in staggering or falling. The ataxia may betray itself even in the handwriting of the patient. In the course of time he regains control over his movements, though his unsteadiness is likely to persist indefinitely, getting worse on excitement. The tinnitus is often a source of great distress. The impairment of hearing is permanent, but, as a rule, stationary and not progressive. In some instances, especially those of a milder type, the spells of labyrinthine apoplexy recur at long intervals. A few times the two ears have been successively attacked in separate spells.

**400.** The well-defined clinical picture sketched in the preceding paragraph constitutes what may with propriety

be called Ménière's disease. It is of comparatively rare occurrence. Common enough, however, are cases which present more or less of the preceding symptoms, but without the clinical history and typical beginning characteristic of Ménière's disease. These less well-defined forms of labyrinthine disease may be said to present Ménière's symptoms. They occur more or less pronounced in all affections of the internal ear, no matter what their etiology and what their mode of onset. The synonym, labyrinthine apoplexy, is justified by the result of at least one autopsy by Ménière, in which a bloody exudate was found in the semicircular canals. As the disease is by itself not fatal, there are scarcely any other satisfactory postmortem records.

**401.** The *treatment* of Ménière's disease is very unsatisfactory. Iodids have been tried and found useless. Pilocarpin has received the credit for an occasional moderate improvement, but with doubtful propriety. It is injected subcutaneously in doses of 6 to 15 milligrams. Others have injected it through the Eustachian catheter. It is not at all certain but what it may be administered just as well by the mouth. Charcot has suggested the use of quinin in single daily doses of 0.5 to 1. for some six weeks, principally for the purpose of relieving the distressing tinnitus and dizziness. He had observed that as the remnant of hearing disappears the noises cease likewise, and claimed that this could be hastened by the steady use of quinin. This claim has been confirmed only to a moderate extent. Quinin should be restricted to those instances in which the hearing power of the affected ear has been damaged enough to make it useless.

**402.** Ménière's disease is in some instances mimicked by spells due to *functional nervous disease.* Hysteric spells, attacks of epileptic equivalents, and even migrain have been known to cause vertigo, nausea and vomiting, as well as tinnitus, for hours. The transient nature of these symptoms and the absence of permanent impairment of hearing exclude actual labyrinthine disease.

Ménière's symptoms without the typical onset of labyrinthine apoplexy occur under a variety of conditions, occasionally as complications of middle-ear disease. It will be most convenient to describe these various affections according to an etiologic classification.

**403.** In the course of **non-suppurative affections of the middle ear** the labyrinth is occasionally, but not often, involved. Whenever there occurs ankylosis of the stapes or ossification of the round window, a gradual atrophy of Corti's organ may follow, which can be detected by the loss of perception of the highest notes of the Galton whistle and the impairment of bone-conduction. The form of disease described in Chapter XXXVIII. as **sclerosis** or rarefaction of the bony capsule of the labyrinth impairs hearing at first only by reason of the rigidity of the oval window, and is not, hence, primarily a disease of the membranous labyrinth. After years, however, it is likely to end in partial atrophy of the nerve terminations. A rare complication of catarrh of the middle ear is a partial and incomplete attack of labyrinthine vertigo—a rudimentary form, so to speak, of Ménière's disease. **Purulent otitis** complicated by **caries** may invade the labyrinth, especially in poorly nourished individuals. The most frequent lesion found in radical operations is a carious spot in the walls of the horizontal, less often the posterior semicircular canal or in the vestibule. It reveals itself by incessant vertigo, sometimes with vomiting fits, and often with nystagmus. Jansen, the only one who has published any experience, does not hesitate to scoop out the carious spot with very small drills or curets, in order to allow the intralabyrinthine pus to escape. In order to avoid the facial nerve this operation must be made either several millimeters behind the Fallopian canal or anterior to it in the region of the promontory. He has obtained a satisfactory percentage of cures. The purulent otitis media of scarlet fever and measles is sometimes complicated by purulent destruction of the entire labyrinth with Ménière's symp-

toms and total deafness. In some instances the whole cochlea becomes necrotic and may be expelled by suppuration.

**404. Traumatism** by means of sharp utensils may reach the labyrinth through the meatus and drumhead and bring on the characteristic symptoms. The internal ear may also become involved in **fractures** of the temporal bone at the base of the skull. There may thus occur a traumatic form of typical labyrinthine apoplexy. Violent disturbances of equilibrium and vertigo have occurred a number of times in consequence of accidental or intentional **exarticulations of the stapes** in the course of operations upon the ossicles. The symptoms have sometimes been mild and transient, but have in other cases necessitated rest in bed for weeks, and even left some permanent impairment. Evidences of labyrinthine involvement—possibly slight hemorrhage—are sometimes observed after violent **blows** upon the ear, occasionally with long persistence of symptoms.

Another external influence which has produced a number of instances of labyrinthine disease with Ménière's symptoms of variable severity is the sojourn in **compressed-air caissons** used in submarine work and bridge-building. The attack comes on when the workman leaves the compressed-air chamber. It is presumably due to the liberation of the absorbed gases in the capillaries of the labyrinth when the external pressure is removed too suddenly. The damage is usually of a permanent character in these cases.

**405.** Unusually loud sounds, especially **explosions,** are likewise an occasional cause of labyrinthine symptoms, mainly in the form of tinnitus or partial loss of hearing. As a rule, the damage is transient. More permanent is the influence of **persistent din,** to which some trades, especially that of boilermakers, are subject. Of mechanics working under such extremely noisy surroundings a large proportion find the hearing gradually impaired in the course of years. Middle-ear affections

seem to predispose to some extent to this so-called **boilermakers' disease of the labyrinth.** But, on the other hand, it has been noticed that whenever more advanced, one-sided middle-ear lesions interfere with sound-conduction, the ear of that side does not suffer so much in the end as its mate. The labyrinth is shown to be the seat of boilermakers' deafness by the loss along the upper end of the auditory scale and the impaired bone-conduction. Tinnitus and vertigo are not usually complained of. It is not quite settled whether the use of firm cotton plugs in the ear affords protection against the influence of such loud dins.

**406. Drug action** has in rare instances injured the labyrinth. Large doses of **quinin** produce a characteristic roaring, which ordinarily ceases within less than twenty-four hours. There are on record, however, a number of instances of more or less complete permanent deafness, always bilateral, traceable to excessive quantities of quinin. Experiments on animals have shown that poisonous doses may cause effusion of blood into the labyrinth. The same has been found true of **salicylate of sodium.** Clinically, however, the latter has very rarely done any permanent damage to the hearing. Yet in rare instances patients claim that a moderate tinnitus, due to middle-ear disease, has been permanently intensified by large doses of salicylate of sodium.

**407.** Labyrinthine involvement, mainly confined to the auditory nerve-ends (partial deafness and tinnitus), is observed in rare instances in the course of various infectious diseases, such as typhoid, typhus, pernicious anemia, etc. There are, however, some forms of systemic disease in which the labyrinth suffers with greater frequency. In **leukocythemia** complete or incomplete attacks of Ménière's disease have been observed repeatedly. **Mumps** is known to localize itself at times in the internal ear, resulting in complete deafness, from which very few recoveries have been recorded. This metastasis, one-sided oftener than bilateral, occurs rarely

at the beginning, oftener during the course or after the termination of mumps. There may be with it some pain and considerable tinnitus.

**408. Syphilis** is accused often as a cause of labyrinthine disease, but according to personal experience, as well as published reports in literature, the localization in the labyrinth is really very rare in the acquired form of the disease. It is apparently more frequent in congenital syphilis, occurring in females more than in males, and usually between the ages of eight to twenty years. Congenital syphilis localizing itself in the labyrinth coincides often with or follows syphilitic keratitis, and the subjects generally show the malformation of the upper incisor teeth known as Hutchinson's teeth. In the acquired form a few casual observations have shown the labyrinth filled with an inflammatory non-purulent exudate, presumably preceded by syphilitic disease of the blood-vessels. Autopsies at a later stage have shown osseous transformation of the labyrinth with disappearance of the nerve-fibers. The labyrinthine affection in both the acquired and the congenital forms may assume the apoplectic type, or may in an acute manner destroy rapidly the hearing without vertigo. In other instances the affection has been of a slower character and sometimes did not proceed to complete deafness. As a rule, it is double-sided. Specific treatment has had no positive effect in most instances. In the slower forms it is not even possible to arrest the disease with certainty. Sometimes, however, moderate recovery has been observed, which by some surgeons has been attributed to the use of pilocarpin in addition to specific treatment.

**409.** A typical labyrinthine affection is a frequent unfortunate outcome of **cerebrospinal meningitis.** Its percentage varies somewhat with the type of the disease. After severe epidemics of cerebrospinal meningitis its victims constitute a large part of the deaf-mutes of the locality. The disease, as well as its labyrinthine complication, occurs principally in children. Its beginning

is usually overlooked on account of the severity of the primary disease and the somnolence or coma so frequently present. As the patient recovers, he finds himself completely deaf and generally distressingly dizzy. The vertigo improves, the staggering gait becomes steadier, after a while incoordination occurs only under trying circumstances, but the deafness remains. Postmortems have shown the lesion to be a suppurative inflammation extending along the auditory nerve into the labyrinth and destroying both the trunk of the nerve and its ends.

A *primary inflammation of the labyrinth* with fever, headache, dizziness, and deafness has been described by Voltolini in children. This affection, however, is now generally believed to be an abortive form of cerebrospinal meningitis.

## CHAPTER XLVII.

### DISEASES OF THE AUDITORY NERVE.—DEAF-MUTISM.

**410. Anatomy of the Auditory Nerve.**—The eighth cranial nerve pursues a short course from its emergence at the side of the medulla oblongata underneath the pons to the internal meatus in the middle of the posterior surface of the petrous pyramid. It is joined by the seventh or facial nerve in its course, which leaves it in the depth of the internal meatus to pass over the vestibule into the Fallopian canal. The auditory nerve consists of two branches really representing separate nerves, the cochlear branch or posterior lateral root, and the vestibular nerve, or anterior median root. The independence of these two branches is shown both by their separate peripheral distribution and their separate central course. Besides, the vestibular nerve receives its medullary investment earlier during embryonic life than the cochlear nerve. The cochlear nerve-fibers pass through the spiral ganglion in the interior of the modiolus. The first neuron of this nerve consists of the fibers in the lamina spiralis, peripheral to the spiral ganglion. The second neuron begins in the latter and terminates in the anterior or ventral and posterior or dorsal auditory nuclei in the medulla. Thence the further path is by means of fibers in the trapezoid body and striæ acusticæ, which, decussating, pass forward in the lateral inferior fillet (lemniscus) to the posterior corpora quadrigemina. Through the subthalamic region and posterior part of the internal capsule they finally reach the cortex of the temporal lobe, in which they terminate. The vestibular nerve is interrupted by a ganglion in the internal meatus, whence its fibers enter the vestibule and ampullæ. The nerve ends

in a dorsal nucleus in the floor of the fourth ventricle. Its subsequent connections have been traced into the cerebellum, but are not yet completely known.

**411. Affections of the auditory nerve** central to the labyrinth are quite rare and are oftener seen by neurologists than by otologists. As in labyrinthine disease, the deafness is characterized by impairment of bone-conduction as well as air-conduction, but, unlike the latter, it is stated that the perception of the highest notes does not suffer first. Tinnitus is, as a rule, not so pronounced as in labyrinthine disease or is even absent. The deafness, too, is not necessarily—indeed, rarely—associated with vertigo. The diagnosis, however, must be based largely on other concomitant nervous symptoms.

The auditory nerve trunk suffers from degeneration in a small proportion of patients with **tabes.** The atrophy is of the same character as the lesion of the optic nerve, which latter, however, is much more common. It is not certain whether there ever occurs a true **neuritis** of the auditory nerve, except as a complication of adjoining inflammatory processes. Deafness, sometimes one-sided, does occur when basilar disease, localized meningitis, or especially syphilitic disease involves the auditory nerve, but all this is very rare. The intracerebral nerve path may suffer from hemorrhagic effusions, tumors, and abscesses. On the basis of the involvement of the auditory nerve, a localizing diagnosis cannot be made, since its symptoms have been observed in consequence of disease of the cerebellum, as well as of the corpora quadrigemina, subthalamic region, internal capsule, and temporal lobe. When the process is distinctly one-sided, it is the opposite ear which becomes deaf. This has a special bearing in the case of abscesses of otitic origin situated in the temporal lobe.

Besides actual deafness disease of the temporal lobe may result in what has been termed word-deafness, or amnesic aphasia. The patient hears, but does not understand the significance of the words. He can repeat the

words mentioned, but he cannot recall the words for independent speech. This mental deafness is observed only when the left temporal lobe is diseased in right-handed subjects, or vice versâ.

**412.** Purely functional deafness occurs at times in **hysteria.** Neurologists often find that in hysteric subjects unilateral anesthesia extends into the meatus up to the drumhead and is accompanied by a one-sided reduction of hearing, of which the patient is not conscious. The hearing can be restored by suggestive influences, such as electricity or metallotherapy. More striking, however, is the occasional occurrence of sudden absolute bilateral deafness in hysteric subjects, usually due to emotions or viciously concentrated attention and sometimes accompanied by speechlessness. The absence of vertigo, of nausea, and of subjective noises distinguishes the hysteric deafness from Ménière's disease. Under suggestive influences hysteric deafness may disappear as suddenly as it occurred, while otherwise it may last indefinitely.

## DEAF-MUTISM.

**413.** Since speech is normally dependent upon the retention and repetitions of auditory impressions, a child born deaf cannot learn to speak in the normal way. Even after speech has been learned it is again forgotten if deafness supervenes before a certain age. This age-limit is about the seventh year, being somewhat variable with the intelligence of the child. It is only after the auditory centers have become fully developed that the impressions once stored up in them remain permanent without fresh additions.

Deaf-mutes are either born deaf or have become so during early childhood. Both classes are about equal in number. The proportion of deaf-mutes to the total population is 66 in 100,000 in this country, and varies in Europe from 43 in Holland to 245 in 100,000 in Switzerland. Males predominate slightly over females. Among the determining conditions heredity is to be mentioned

in the first place. Among the descendants of deaf-mutes the defect occurs in every eleventh instance according to statistics, while parents with normal hearing have but one deaf child in every 10,000. Statistics further show that the hereditary influence is not merely a matter of direct transmission, but that the chances of deaf progeny are very much increased by the occurrence of the same anomaly among the brothers and sisters of the parents, even if the latter be normal. The family influence is often revealed by the multiple occurrence of deaf-mutism among many or all the children of one family. It has also been shown that the first child runs greater chances of deafness than the subsequent offspring. Consanguinity of the parents seems a predisposing factor; more so, however, by the cumulative effect of unfavorable family influences than merely by inbreeding. Other instances of degeneration, idiocy, epilepsy, and retinitis pigmentosa appear often in the family history.

The direct cause of congenital deafness is mainly an inflammatory affection of the labyrinth, sometimes localized more in the semicircular canals, sometimes more in the cochlea. The inflammatory lesions are seen only in early autopsies. In later examinations the labyrinth is found ossified and sometimes apparently absent. Malformations of the petrous bone, suggested by narrowness or even obliteration of the internal meatus and a rudimentary condition of the tympanic cavity, are not often observed and may be secondary to a fetal labyrinthine inflammation. In some instances the third frontal convolution of the left side of the cerebrum and the adjoining part of the island of Reil have been found atrophied, evidently because the speech center has never become developed.

Acquired deaf-mutism is the result of the various labyrinthine affections described in the previous chapter. In most statistics cerebrospinal meningitis occupies the first place in etiology. Next to it come scarlet fever, diphtheria, measles, and syphilis. The other infectious dis-

eases and brain diseases like internal hydrocephalus are less frequent causes.

**414.** In acquired deaf-mutism the hearing is almost always totally destroyed. In the congenital form, however, it is not uncommon to find remnants of auditory perception comprising a small range of tones in different parts of the scale. In the acquired form dizziness may persist to a variable extent for many months after the beginning, but it always ceases in the end. Most deaf-mutes, however, do not possess perfect coordination, at least in difficult movements. Feats of balancing, for instance, are learned only with difficulty and depend mainly on the control by sight. On the other hand, the majority of deaf-mutes are not made dizzy by whirling on account of the destruction of the semicircular canals. The intelligence of deaf-mutes is usually not impaired; they are often very bright and observant. It is noticeable, however, that they are apt to be emotional and lack self-control, which may be partly the result of insufficient training, partly the expression of a degenerative tendency. A striking fact is the frequent occurrence of an enlarged pharyngeal tonsil at least in one-third, and according to some authors in two-thirds of all deaf-mutes. However important the removal of this anomaly may be, it must not be expected to benefit the hearing.

Unless specially trained, deaf-mutes utter no sounds except a few inarticulate tones of emotional origin. Their natural mode of communication is by gestures. As a rule, they learn reading and writing very easily under competent teachers. Formerly the letters were taught them by sign language or by movements of the fingers and hands. Their sphere of utility is, however, much enlarged by learning to speak and to read language by watching the lips. The younger the training is begun the easier it is for a child to acquire this skill, and the more nearly perfect will be his enunciation. The speech of a deaf-mute will always betray him to an experienced observer, but in many instances he can get along ex-

cellently for an active business career. Good teachers prefer to begin instruction before the fourth year of life. When there is any remnant of hearing left, its methodic exercise enlarges the mental horizon and improves the enunciation. The exercise is carried on by speaking into an ear trumpet.

**415.** Deaf-mutism is in rare instances simulated by a peculiar form of mental disturbance in children. This was first described by Wilde, but has received very little attention in otologic literature. Recently some cases were reported by Moyer, and the writer has personally seen 3 instances. These children do not acquire speech and apparently do not understand words addressed to them. Some of them are quite apathetic as regards noises of any kind or as regards speech. Yet in several instances closer tests showed that words spoken in only moderately loud tones were distinctly heard when the child's attention was enforced. The words could be correctly repeated, and when the child was willing, it could follow commands which it evidently understood. There was hence no complete deafness, though undoubtedly some defect of hearing. Neither was there entire inactivity of the sensory or motor parts of the speech center. The defect is evidently one of mental origin, and can probably be partially or wholly overcome by persistent patient training.

## PLATE II.

FIG. 1.—Normal membrana tympani (left ear—adult).

FIG. 2.—Retracted drumhead; boy with adenoids and neglected Eustachian catarrh (right ear).

FIG. 3.—Yellowish exudate within the tympanic cavity, seen through a slightly cloudy drumhead in a middle-aged man who had had several previous attacks of serous catarrh (right ear).

FIG. 4.—Cloudy and slightly retracted membrane; elderly woman with adhesive middle-ear disease of long duration (right ear).

FIG. 5.—Right drumhead in acute otitis which healed ultimately without perforation (girl of eighteen years).

FIG. 6.—An old healed scar in the (left) membrane after purulent otitis. Hearing slightly impaired.

FIG. 7.—Acute otitis media on the second day (right ear).

FIG. 8.—The drumhead of Fig. 7 two days later, after paracentesis had been done and gauze drainage maintained.

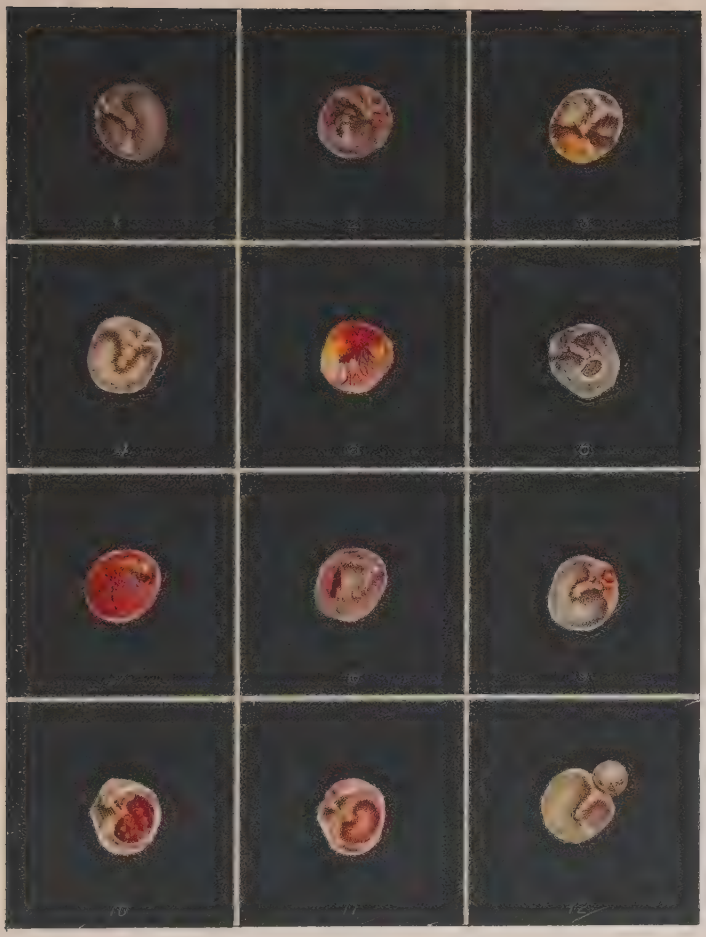
FIG. 9.—Old case of suppuration of the attic with perforation in Shrapnell's membrane, through which the injected mucous membrane is visible; the (right) drumhead slightly cloudy and retracted; fair hearing.

FIG. 10.—Chronic purulent otitis dating back to scarlet fever, with large perforation, through which the mucous membrane of the internal tympanic wall is seen swollen and granulated (left ear).

FIG. 11.—The drumhead of Fig. 10 three weeks later, after the disease had been healed by boric acid insufflations; the tympanic lining is now pale and smooth; the handle of the hammer is adherent to the inner tympanic wall (young girl).

FIG. 12.—Defect caused by former caries in the bony margin around Shrapnell's membrane; a cholesteatomatous collection in the attic protrudes through the gap; no discharge at the time; fair hearing, although the drumhead is thickened.

# Plate II.



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